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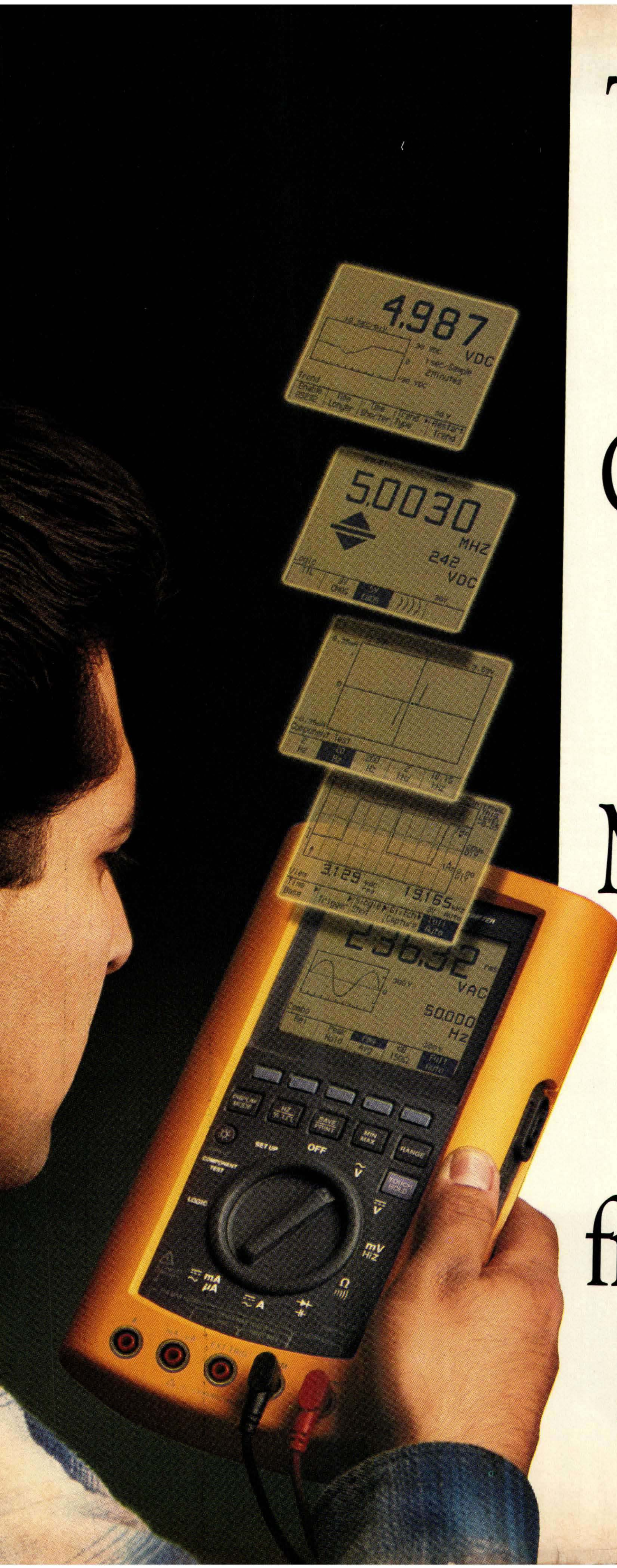

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CHNOLOGY UPDATE

reakthrough *wireless* security ystem causes industry uproar...

dvanced 360° passive infrared alarm system offers features not und even in systems costing five times as much.

John Lindner

If the predictions are true, the days could be numbered for traditional alarm systems. In a development which shocked industry siders, Guardtech unveiled a new wireless curity system which challenges even the most phisticated alarms.

The system, called e Snitch, uses portable frared motion detec- rs in conjunction with base console and key ain remote to offer atures never before ailable—even in sys- ms costing thousands dollars.

ltimate protection. he Snitch's microchip chnology gives it the bility to provide supe- or security without e installation night- are of traditional larms. The three com- onents of the Snitch ommunicate with each ther using radio aves, so there are no umbersome wires to other with. The whole ystem can be installed y you in just minutes. Vhat's more, the Snitch ives you the option of nking to a monitoring ervice—the same one sed by systems cost- ng up to $10,000—for ltimate security.

Total flexibility. The Snitch covers up to 1,400 square feet. You can add up to three additional motion detectors for up to 6,000 square feet of protection. Plus, only the Snitch lets you adjust the scope of the infrared detection. Using special blockers, you can adjust the area from 360° down to as low as 90°. The detector also has a built-in height adjustment.

Easy to use. The Snitch is one of the easiest systems to install and operate available. Simply plug it in and follow simple instructions—it sets up in minutes. Then you can arm or disarm by pushing a button on the key chain remote. No more dashing in and out before the alarm is activated—with the Snitch, you can turn it on or off from up to 100 feet, even through walls!

Complete security. The Snitch also gives you the option of activating a 24-hour, professional monitoring service that will dispatch help when the alarm is tripped. The service is just $12.95 a month with no long-term commitment.

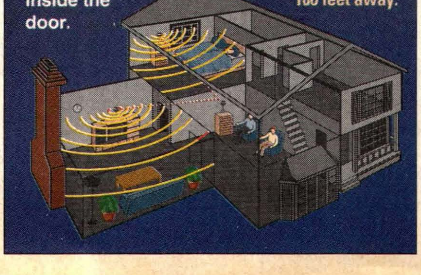
HOW DOES THE SNITCH WORK?

The Snitch system consists of a passive infrared motion detector, a key chain remote and a base console. The motion detector picks up movement within a 1,400-square-foot area and instantly reports to the base console. The base console sounds a loud siren, notifying you of the intrusion. It also has the option of triggering a call to a professional monitoring service.

The alarm can be armed or disarmed with the push of a button on the remote, which has a 100-foot range. It can even transmit signals through walls so you can arm and disarm the system before you even step inside the door.

THE SNITCH

- World's first 360° portable motion detector.
- Use up to four motion detectors and eight remotes for 6,000 square feet of protection.
- Uses same monitoring services as systems that cost $10,000.
- Arm, disarm and trip a panic alarm from up to 100 feet away.



THE SNITCH

VS. OTHER ALARMS

Compare the Snitch to other alarms. You'll find many advantages in addition to its portability and convenient operation.

Installation	
☑ You can install the Snitch in just minutes.	☐ Security companies often charge high fees.
Value	
☑ The Snitch is available at a very low price.	☐ The average alarm system costs $1,385.
Monitoring expense	
☑ Monitoring is $12.95 with the Snitch with no long-term commitment.	☐ Monitoring averages $22.95 and requires a long-term agreement.
Protection	
☑ The Snitch's 360° passive infrared motion detector can be placed anywhere—even the room you are sleeping in.	☐ Most motion detectors have 90° passive infrared detection that must be turned off in the room you sleep in.
Ability to expand	
☑ With the Snitch, use up to four motion detectors and eight remotes with one base console.	☐ Traditional alarms require professional installation to expand their coverage.

Try it risk-free. The Snitch is backed by Comtrad's exclusive risk-free home trial. Try it and if you're not totally satisfied, return it within 30 days for a full "No Questions Asked" refund. It also comes with a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

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Through this limited-time introductory offer, the Snitch, which includes base console, infrared motion detector, key chain remote, batteries, Guardtech window stickers and video, is available directly to you for three payments of only $79. Plus, if you call this month, we will throw in a FREE month of 24-hour professional monitoring. Call now to take advantage of this special offer.

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Electronics NOW

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ON THE COVER

31 GREEN PCs

In today's economic environment, saving money is more important than ever. And the state of the world's ecological environment makes conserving energy another important consideration. You can save money and protect the environment at the same time by choosing and using "green" computers and peripherals. The Environmental Protection Agency (EPA) estimates that PC systems now account for more than 5% of total U.S. electrical power consumption, and that figure continues to increase rapidly. Computer manufacturers have tried to stem the tide, not by selling fewer systems, of course, but by creating energy-saving computer systems that use little or no power when not in active use. PCs and peripherals that meet the EPA's Energy Star guidelines can save you money, and are more ecologically sound than traditional equipment. Here's a close-up look at those guidelines, and what goes into a green PC.

— *TJ Byers*

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Build the Power Pincher
and turn any computer monitor green!

BUILD THIS

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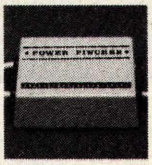
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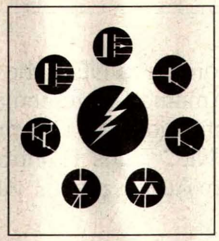

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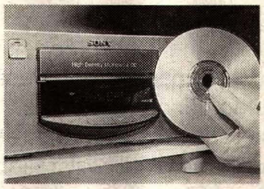

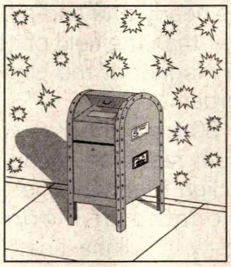

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WHAT'S NEWS

A review of the latest happenings in electronics.

Silicon audio player

NEC Corporation has developed a portable music player that reproduces compact disc-quality sound with instant random access from audio data stored on a semiconductor flash-memory card. Silicon Audio is more compact and weighs less than standard cassettes or digital audio tape, and it requires no moving parts to be played. That eliminates unwanted vibrations and jumping problems that plague compact disc, and tape playback systems.

The memory cards are the size of credit cards. The prototype unit can compress a 20-kHz, 770-kilobyte-per-second audio signal to one-eighth of its uncompressed length. This permits 24 minutes of recording from a 23-megabyte memory card.

MEMORY CARD

A SOLID-STATE AUDIO PLAYER based on flash memory cards from NEC will store and play back audio with the quality of a compact disc.

After encoding and compressing the audio signals, the Silicon Audio player records the signals on semiconductor memory chips on the memory card. Data decoding and playback are in real time.

Silicon Audio combines Moving Picture Experts Group (MPEG) and audio-decoding large-scale ICs, developed by NEC, with standard memory card ICs to achieve what NEC claims is superior wideband audio-signal compression and reproduction that will match the quality of CD sound.

According to NEC, the semiconductor memory card can also store text, still pictures, and moving images. NEC plans to introduce the Silicon Audio player within two years.

Approaching world's most powerful magnet

Researchers at Los Alamos National Laboratory in New Mexico have successfully tested two of nine coils of a multiton magnet. When completed later this year, the magnet will be the most powerful magnet of its kind in the world. Recent tests by the laboratory have validated the magnet coil design and manufacturing procedures.

The tests also demonstrated that the coil material will reliably and safely withstand the electrical and mechanical stresses of the new 60-tesla magnet. A 60-tesla magnetic field is 1.2 million times the strength of the Earth's magnetic field. This value is nearly one-and-a-half times stronger than the field of its closest rival, a magnet at the University of Amsterdam.

The 60-tesla magnet will be an important resource at the new National High Magnetic Field Laboratory, located at Florida State University in Tallahassee. The laboratory is sponsored by a consortium made up of Florida State University, the University of Florida, and Los Alamos National Laboratory. It is financed by the National Science Foundation.

Scientists make use of high magnetic fields to reveal the fundamental electronic and optical properties of matter, learn how materials behave in high magnetic fields, and study the makeup of atomic and molecular material. Higher magnetic fields lead to more comprehensive data.

The magnet will become a research tool that will fill the void between two existing extreme magnetic field conditions: large fields that last only microseconds or smaller fields that can be sustained for days. The new magnet will be able to produce a steady 60 tesla for a tenth of a second; it will also be able to produce pulsed and variable fields.

The magnet, designed by Los Alamos scientists, consists of nine nested coils that are mechanically independent. The copper-alloy coils not only are improvements on previous magnetic coils, but they have also solved earlier insulation and heat dissipation problems that have occurred in high-field, pulsed magnets.

The coils are combined electrically into three groups and will be pulsed sequentially to reduce heating and allow rapid cooling and turnaround time. This configuration will allow researchers to pulse the magnet again in less than an hour after it has been a pulsed.

The magnetic field behavior can be customized and optimized for different experiments. The designers report that their design concept can be expanded to generate 100 tesla without having the magnet destroy itself.

The longer high-field pulse length and relatively large sample chamber require high energy—more power than can be supplied by a commercial power grid. A 1.4-billion-watt electrical generator, intended for a nuclear power plant in Tennessee that was canceled, will power the magnet.

IBM sets patent record

IBM was issued more U.S. patents in 1994 than any single company has ever received in a calendar year. According to IFI/Plenum Data Corporation, IBM received 1298 patents in 1994, topping its closest competitor, Canon of Japan, by 199 patents. IBM also ranked first in U.S. patents awarded in 1993, the first year since 1985

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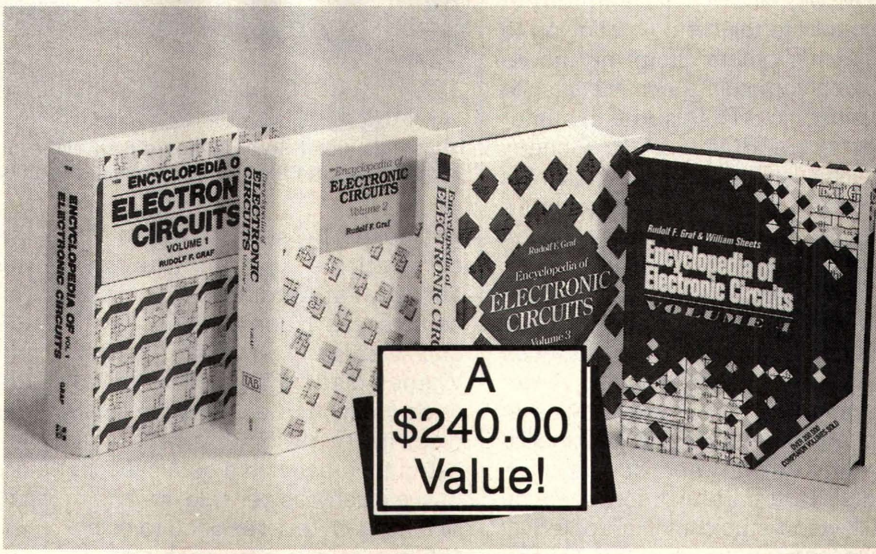

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VIDEO NEWS

What's new in the fast-changing video industry.

DAVID LACHENBRUCH

The single-sided Sony-Philips digital video disc (DVD), pictured above, faces stiff competition from the recently unveiled Toshiba-Time Warner double-sided version.

- **DVD coup.** Sony and Philips, proprietors of basic patents on the compact disc and its variations, including CD-ROM, were shocked by an apparent coup d'etat when major Hollywood and consumer-electronics interests backed a competing proposal for a digital video disc (DVD) system over their proposal, which had generally been considered the favorite. Working quietly behind the scenes, Toshiba and Time-Warner mustered the support of MCA, MGM/UA, and Turner Home Entertainment (in addition to Warner Brothers) from the movie-making community, and Matsushita (Panasonic), Thomson Consumer Electronics (RCA and GE), Pioneer, Hitachi, JVC, and Nippon Columbia (Denon) from among consumer-electronics manufacturers—in addition, of course, to Toshiba.

Both the Sony-Philips and the Toshiba-Time Warner systems were designed to extend the capabilities of the 5-inch compact disc to accommodate full-length movies in digital storage with quality exceeding that of the laserdisc. Both formats were carefully screened by Hollywood studios as the potential successor to tape as the chosen format for prerecorded entertainment—particularly movies. However, the chosen format also has implications for other types of storage, particularly as a CD-ROM with five to seven times the capacity of today's version. As reported here (*Electronics Now*, March 1995), the Sony-Philips proposal envisioned a single-sided, high-density disc, 1.2 mm thick, capable of storing 3.7 gigabytes of data and claimed to be capable of holding a 135-minute movie. There is the possibility of doubling the capacity some time in the future by switching to a dual-layer disc, using a reflective-transparent coating for the top layer, with the focus of the playback laser variable to read either the top layer or the bottom layer recording.

The Winner? Sony admittedly was taken by surprise when the competitive system was presented—at simultaneous news conferences in Los Angeles, Tokyo, and Osaka. The Toshiba-Time Warner disc demonstrated at all three locations was a double-sided disc. Its two 0.6mm sides, laminated together, had a data capacity of five gigabytes per side, for a total of ten gigabytes, designed to hold a 135-minute movie on each side, or various combinations—for example, a movie on one side, a video game based on the movie on the other side.

Taken aback, Sony first said the system was more difficult to produce than the 1.2mm disc. However, Warner said that it had already produced 50,000 discs in trial runs at its CD-pressing facility, and the estimated cost in mass production would be about 25% higher than an audio CD. Toshiba and Time Warner said that the additional capacity of their disc over the Sony-Philips version would make possible higher quality recordings, particularly of movies that are difficult to digitize because of rapid scene changes and fast action.

The Toshiba disc has an average playback rate of 4.94 megabits per second (Mbps) for a 135-minute movie. That can be extended to 142 minutes at a lower rate of 4.69 Mbps. In either case, it can accommodate Dolby AC-3 digital audio, three language channels, and four subtitle channels. As demonstrated at the news conferences side-by-side with laserdisc, the DVD images were noticeably better—sharper, with more subtle texture gradations and far better color. As shown alongside the same movie played back from a digital D-1 broadcast videotape recorder, the difference was indistinguishable to observers.

Warner says that it will produce movies on the new format for sale at the same price as it does videocassette movies, and both Matsushita and Thomson said that they plan to introduce players in the second half of 1996 to retail at about $500. The players will be "backward compatible" with audio CDs—that is, they will be able to play audio CDs, but the digital video discs will not be playable on today's CD players. Movie interests forecast that the launch will be accompanied by 250 movie titles.

The system obviously can't be a

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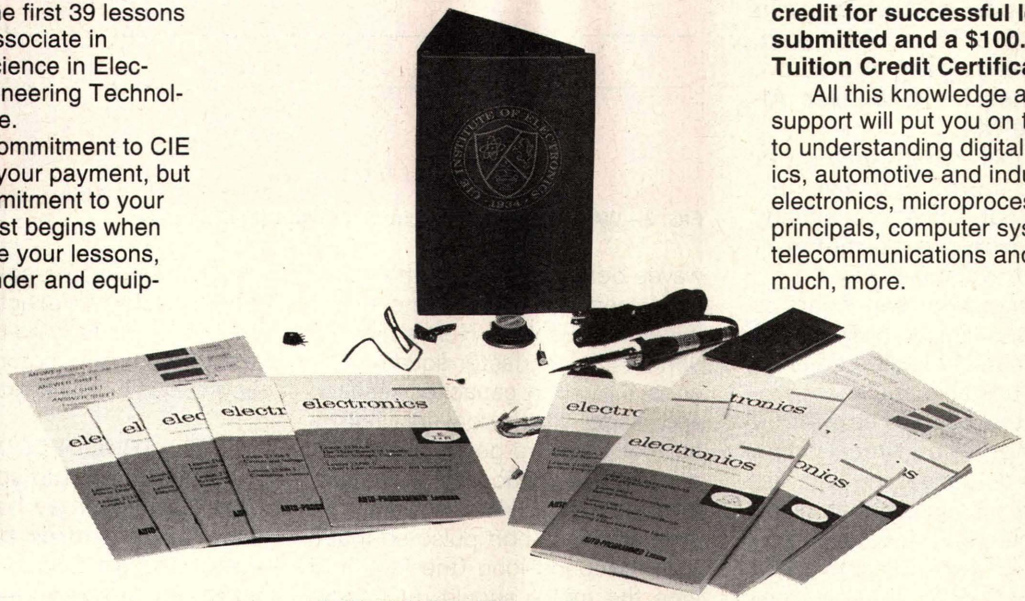

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Q & A

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ONE FOR THE BIRDS?

I want to build an incubator for hatching birds' eggs. This requires that the eggs be gently moved about once an hour. I have a reversible AC motor, geared down to 1 rpm. I need a circuit to run the motor forward for 10 seconds, wait an hour, run it backward for 10 seconds, wait, run it forward again, and so on. Can you help?—R. Weaver, Albuquerque NM.

Actually, this sounds like a job for a stepper motor and a microcontroller, but since you already have the reversible AC motor installed, try the circuit in Fig. 1.

One cycle every two hours is much too slow for an ordinary RC oscillator; it would require an enormous (and unstable) capacitor. Accordingly, the circuit has a 4060 CMOS long-period timer, which consists of an oscillator plus a series of binary counters that divide the frequency by 2, 4, 8, and so on up to 16,384. The oscillator runs at a comfortable 2 hertz (2 cycles per second), controlled by a capacitor and two resistors, and the binary counter divides this down to produce a square wave that has only one cycle every 2 hours, as well as another one that oscillates twice as fast (see Fig. 2).

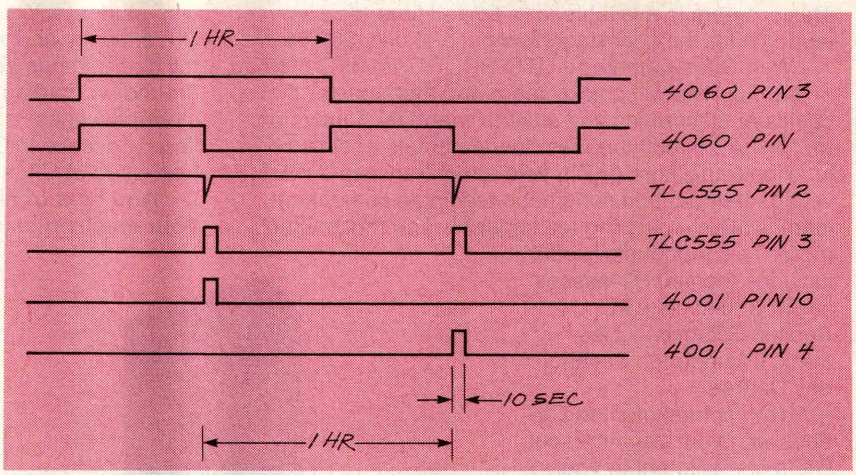


FIG. 2—WAVEFORMS in the circuit of Fig. 1 (not to scale).

The faster of the two square waves determines when the motor runs, and the slower one determines its direction. Here's how it's done: First, the faster square wave goes through a capacitor, resistor, and diode, which convert it into a narrow negative-going pulse that occurs once per hour. Then the 555, connected as a monostable, stretches the short pulse so that it is 10 seconds long (the length of time the motor should run). Logic gates then steer that pulse to one of two relays so that the motor runs either forward or backward, depending on which state the slow square wave is in at the time. Because the forward and reverse pulses are generated by the same 555 circuit, they are the same length—important so that the reverse cycle will exactly undo the motion of the forward cycle. Wiring the relays to the motor is left up to you. Good luck with your eggs.

TONE DECODER

I am hoping that you or one of your readers may have a cross reference and/or pin assignment for an SSI 20C90 DTMF chip.—J. Lubben, Deer Park, TX.

DTMF (dual tone multi frequency) signals are the tones used for telephone dialing; they are also used for other purposes, such as control of ham radio repeaters. Each tone consists of two sinewaves transmitted simultaneously, one indicating the row on the keypad and one indi-

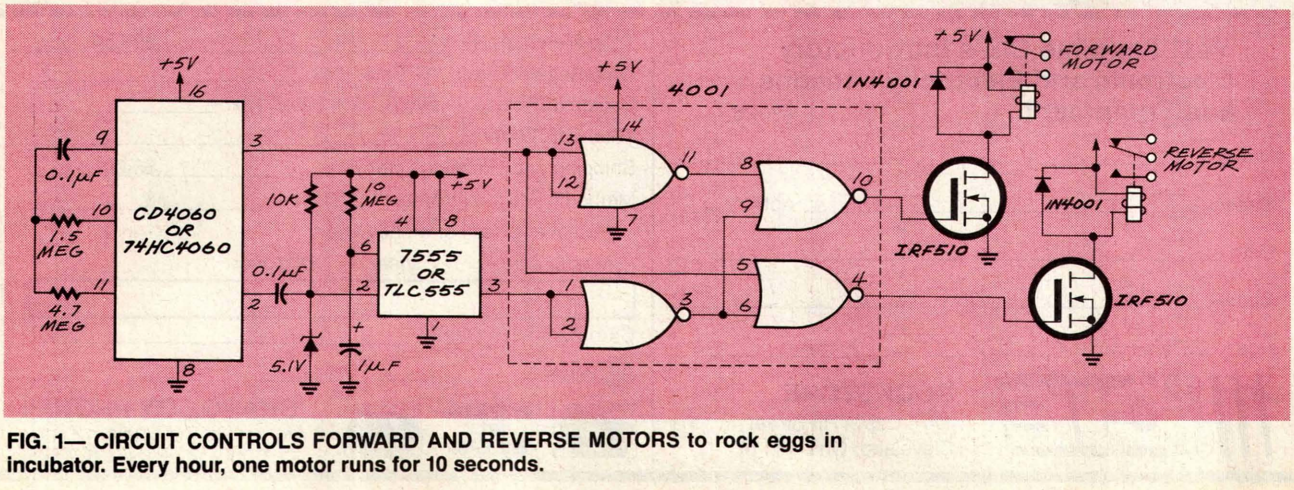
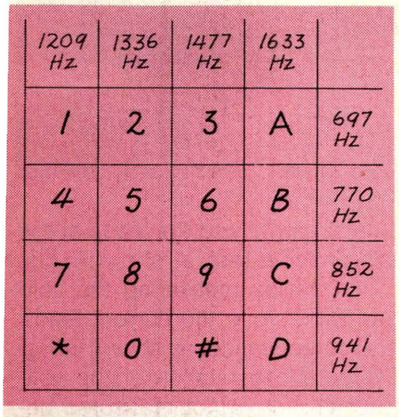


FIG. 1— CIRCUIT CONTROLS FORWARD AND REVERSE MOTORS to rock eggs in incubator. Every hour, one motor runs for 10 seconds.



1209 Hz	1336 Hz	1477 Hz	1633 Hz	
1	2	3	A	697 Hz
4	5	6	B	770 Hz
7	8	9	C	852 Hz
*	0	#	D	941 Hz

FIG. 3—EACH DTMF SIGNAL consists of two sinewaves transmitted simultaneously, one indicating the row on the keypad and one indicating the column.

cating the column, as shown in Fig. 3. For example, the digit 5 is transmitted as 770 Hz and 1336 Hz. The codes in the rightmost column (A, B, C, and D) are not normally available on consumer equipment.

SSI (Silicon Systems, Inc.) makes ICs that recognize and decode DTMF tones. Several SSI chips (though not this particular one) are described in The ARRL Handbook for Radio Amateurs, published by the American Radio Relay League, Newington, CT 06111—a book every electronic tinkerer should have. For data on the 20C90, you can write to SSI at 14351 Myford Road, Tustin, CA 92680.

ELECTRONIC CLOCKWORK?

In 1977 I assembled a 6-digit LED clock kit. Now, 17 years later, the clock has failed, and I can't get a replacement for its CT7001 clock chip. Could you direct me to plans for a similar clock kit that is still available?—P. Smith, Thousand Oaks, CA.

Certainly. LED clock kits and parts are available from Jameco, 1355 Shoreway Road, Belmont, CA 94002-4100. Although their catalog does not list a CT7001, they'll know of a replacement if one exists.

METER SHUNTS

What type of shunt do I need to measure 50 amperes on a 50-microampere meter, and where can I get one?—Steve Baumfalk, Norfolk, NE.

A shunt is a small resistor connected across a current meter to make it read a higher range of current than it normally could. For example, a 1-milliampere meter can read 100 milliamperes full scale with the proper shunt (see Fig. 4).

To calculate the resistance of the shunt, you have to know the resistance of the meter. You can measure this with an ohmmeter, but make sure the ohmmeter doesn't send too much current through the meter movement that you're testing. For best results, use a digital multimeter (DMM) set to its 20-kilohm or higher range, and switch to lower ranges only if necessary. You'll find that the resistance of your 50-microampere meter is probably a few thousand ohms. Then you can find the shunt resistance:

$$R_{SHUNT} = (R_{METER} \times I_{METER})/(I_{TOTAL} - I_{METER})$$

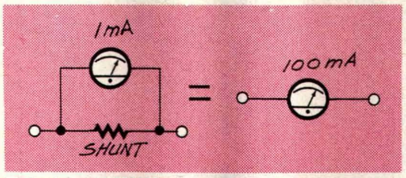


FIG. 4—A SHUNT is a resistor connected across a current meter to make it read a higher range of current than it normally could.

The current can be in amperes, milliamperes, or microamperes, as long as you use the same units in all three places in the formula. For example, if you had a 1-milliampere meter with a resistance of 1000 ohms, and you wanted to make it read 100 milliamperes full-scale, you'd plug in the following values:

$$R_{SHUNT} = (1000\ \Omega \times 1\ mA)/(100\ mA - 1\ mA)$$
$$= 1000/99$$
$$= 10.1\ ohms$$

A 10-ohm resistor will do just fine; in general, it's sufficient to get within a few percent of the correct value.

Now back to your problem. Yours is a special case because you want a million-to-one change of scale (50 amps to 50 microamps). Suppose the resistance of your meter turns out to be 6000 ohms. Then you'll calculate as follows:

$$R_{SHUNT} = (1000\ \Omega \times 50\ \mu A)/(50{,}000{,}000\ \mu A - 50\ \mu A)$$
$$= 50{,}000/49{,}999{,}950$$
$$= 0.001\ ohm$$

They don't make resistors that

Continued on page 93

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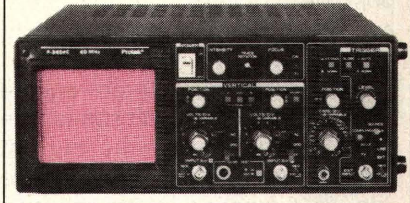

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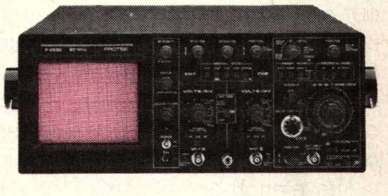

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LETTERS

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MILLIOHM TESTER MODIFICATIONS

I read the article "Build this Milliohm Tester" (*Electronics Now*, February 1995) and I found some possible problems with the circuit and would like to suggest ways to simplify it.

Approximating a current source with a voltage source in series with a resistor will allow the current through the resistor under test to vary as a function of the unknown resistor's value. Although that reference current error will be small for small values of R_X, I would suggest a three-terminal voltage regulator as a *current* source, as shown in Fig. 1.

IC1 is an ECG956 (or equivalent) positive adjustable voltage regulator that has a 1.2 voltage reference between its OUT and ADJ terminals. A 12-ohm resistance (R1 and R2) connected between IC1's OUT and ADJ terminals sets the regulator's output current to 100 milliamperes. To calibrate the circuit, connect a digital ammeter in place of R_x and adjust R2 to get a current of 100 milliamperes.

I have another criticism of the article's circuit: *Never* connect the current source and voltage measurement leads together before connecting any device under test in any kind of four-wire resistance measurement. If you do, you'll be measuring the resistances of the contacts between the current leads as well as the resistance under test. This is shown in Fig. 2.

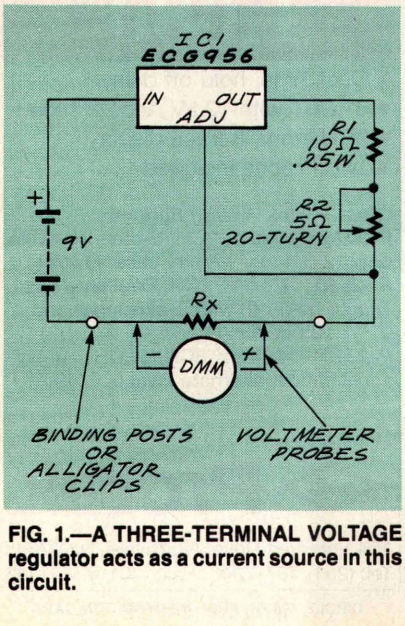


FIG. 1.—A THREE-TERMINAL VOLTAGE regulator acts as a current source in this circuit.

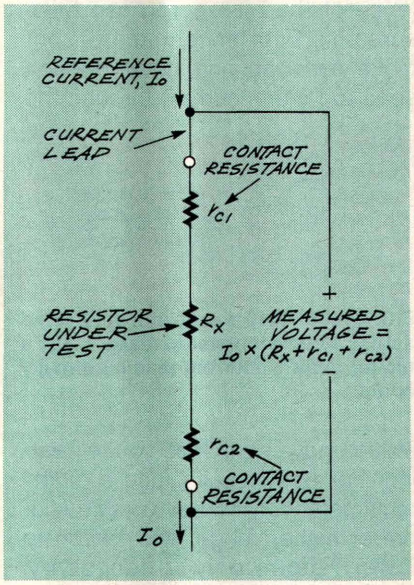


FIG. 2—TYING THE VOLTAGE and current leads together adds contact resistance to the measurement.

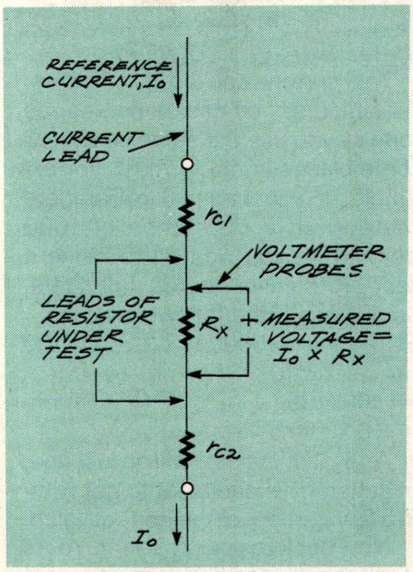


FIG. 3—A TRUE FOUR-WIRE resistance measurement hookup.

Instead, connect the current source and voltage measurement leads separately to the leads of the resistor under test, as shown in Fig. 1. That avoids measuring the voltage drop across the current lead's contact resistance, as shown in Fig. 3. (Contact resistance of the voltmeter probes is not measured because a digital multimeter draws no current.)

Note also that the circuit shown in Fig. 1 requires fewer parts than that in the published article. Moreover, a power switch is not needed because the Fig. 1 circuit draws no current when there is no R_X connected.

GARY TONG
White Deer, PA

SIGNAL THEFT

Thank you for publishing a fine electronics magazine. I enjoy the wide editorial coverage of the electronics industry.

I'm writing in response to the "Signal Theft" article (January 1995). Scrambling and descrambling techniques are of great interest to me. Although the article was good, I believe that there are many sides to the issue.

First, consider cable TV as a utility; it is a monopolistic one at that. I pay my local cable-TV provider to deliver non-premium service to a terminal on the back of my house. Their only obligation beyond that is to deliver a clear signal.

Second, look at the other utilities that service my house: electric, water, and telephone. The electricity and water are metered and I pay for the quantity I use. However, once all three of these services are installed in my house, I can do whatever I want with them as long as I don't interfere with their delivery. I can even choose not to use any of them and seek alternative sources.

For example, I can use the electricity as is, transform it up or down, rectify it or connect a wire so my neighbor can use it. Similarly, I can use the water just as it enters the house or I can heat it, cool it, freeze it, or give it away. As for the telephone service, I can speak over the phone or send data over it with a modem or fax. I can even add extra phones or answering machines.

The point is, if I have paid for a service to be delivered to my house, I believe that I should be able to do whatever I please with that service in the confines of my home, as long as it doesn't interfere with the service's distribution.

I don't think of cable-TV signals as different from these other services. If the cable company does not take steps to limit or control the incoming signal with its equipment, I should be able to do whatever I want with the signal in my home. Yes, even descramble it if I had the equipment and were inclined to do so.

Satellite program services have taken a similar approach; they have added some sophisticated techniqes to their VideoCypher scrambling method. No "pirates" have been successful in breaking the VCRS board to receive the television audio from it without subscribing, and satellite piracy has been virtually eliminated. If cable-TV distributors are to achieve the same kind of control, extensive equipment upgrades will be required.

I do not think that we will see that happen as the competitive threat of the small-dish TVRO industry continues to grow. Programming bargains are becoming more widely available as the competition heats up. That will benefit us TVRO owners. (Yes, I have both cable and a satellite dish.)

The cable TV companies will receive their comeuppance for their lousy service, poor quality signal, and indiscriminate and frequent rate increases when the TVRO industry increases its offerings.

The operative word in my examples is *ownership*. Once a service enters my home, ownership is transferred to me so that I can use that service as I please. That includes altering the state of the service or product to my preferences. After all, who would want to take a cold shower in the dark and have the only phone in the house ringing in another room?

J. DARRELL GAMMON
Cary, NC

TV-SERVICE TIP

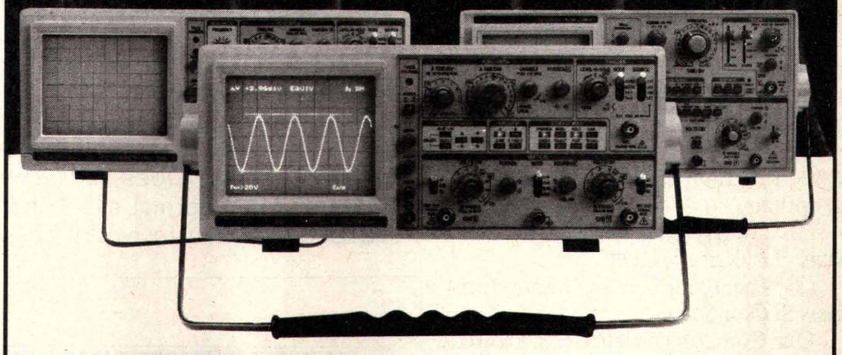
I service television sets for a living, and I've found a way to check for open electrolytic capacitors.

My oscilloscope has a 1-kHz squarewave output jack for calibration. Because it has an output impedance of about 1500 ohms, a capacitor connected between it and ground will cause integrate the signal, depending on the value of the capacitor.

I connect my oscilloscope probe to the jack and use several test leads, one from the jack and one from ground to find defective electrolytic capacitors. Any capacitor with a value above about 10µF will show up as a straight line trace (as will a short circuit, so be careful).

A good 1- to 10-µF capacitor will show up as a triangle waveform. An open capacitor will, however, not show any pattern, just add noise to the square wave, or give a reduced amplitude squarewave, depending on the resistance in parallel with the capacitor.

WAVE GOODBYE TO PRICEY TEST EQUIPMENT



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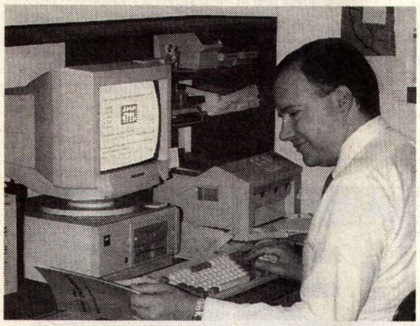

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ARDELL FAUL
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IN DEFENSE OF CSICOP

The letter from Benson Boss (*Electronics Now*, January 1995) condemning the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) requires an answer. I will take on his points one by one:

1. He says that CSICOP condemns before investigating. Can he give me an example of that? CSICOP has investigated countless claims of paranormal events. In many cases, the claims have absolutely nothing but anecdotal evidence to support them.

Plenty of television talk shows provide a large audience for people who want to make fantastic claims. I certainly don't want CSICOP to join that parade. Just remember that the second and third words in CSICOP's title are "scientific investigation."

Mr. Boss claims that the committee picks on weak, absurd, and vulnerable reports of the paranormal. That probably represents most paranormal claims. Does he know about any paranormal event that CSICOP refuses to explore because that event could possibly be real? I'm sure CSICOP will pay particular attention to any paranormal claim that seems to be truly remarkable.

Mr. Boss condemns CSICOP for demanding physical evidence to substantiate claims. No one who believes in the scientific method should ever settle for less. Anyone can make up a fantastic story. No organization could possibly investigate every idiotic claim made in a world that does not seem to have a shortage of crackpots.

Finally, Mr. Boss believes that it is professors, intellectuals, and scientists (the sort of people who make up CSICOP) who prevent the introduction of any fundamentally new ideas in politics, religion, medicine, and science. Well, just who *has* made the major contributions in those areas?

The readers of *Electronics Now* are interested in electronics. There is no doubt that the incredible advances being made in that field are being made by just the kind of people Mr. Boss thinks are too narrow-minded to achieve such accomplishments.

Everyone interested in learning about CSICOP should read its journal, *Skeptical Inquirer*.
RICHARD W. STICKA
Yorkville, IL

Continued on page 93

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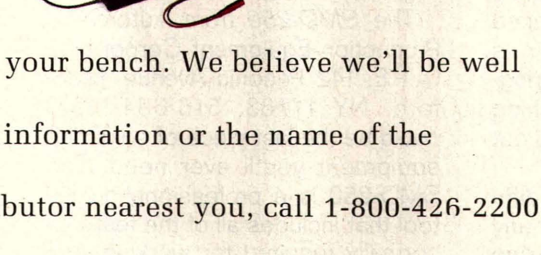

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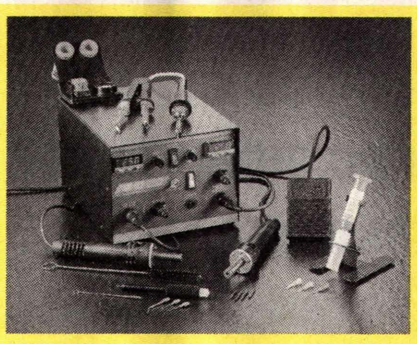


The soldering iron is perhaps the most important tool for assembly and repair work in electronics. The basic soldering iron can tackle nearly any job involving common leaded components—not only assembly and installation work, but disassembly and repair work as well.

In skilled hands, no work with leaded components is too delicate for an ordinary soldering iron. But experience is the only way to learn how long to hold an iron in place and how much solder is sufficient.

Disassembly work can also be done with a soldering iron and either a plunger-type "solder sucker" or a piece of desolder braid. Most hobbyists are familiar with the manually operated plunger-type solder suckers that must be cocked before use. After a solder joint is melted with an iron, the sucker is placed over the joint, and a trigger is pressed that releases the spring-loaded plunger and, if everything goes right, the solder is sucked out of the joint.

Because solder suckers are difficult to operate effectively, many people prefer to use desoldering braid. Desoldering braid is placed over a solder joint, and is heated along with the solder. As the solder melts, the braid soaks it up. After the solder has been removed from all of an IC's pins, the part can usually be removed from the board fairly easily.

Unlike through-hole components, surface-mounted components usually require specialized tools. Some surface-mount work can be done with a regular soldering iron, but not much. For example, disassembly or repair work on surface-mount components is next to impossible with a regular iron, because surface-mount components must be removed by simultaneously melting all solder joints and lifting the part off the board. There is no way to effectively heat all of an IC's pins at once with an ordinary soldering iron.

Surface-mount assembly and repair work requires special tools: tools to dispense special solder, others to melt it, and yet others to remove a part already soldered in place.

The SMD-250

The *SMD-250* from Automated Production Equipment Corporation (A.P.E, 142 Peconic Avenue, Medford, NY 11763, 516-654-1197) could be the last piece of soldering equipment you'll ever need. The SMD-250 is a professional-quality tool that includes all of the features normally required for working with both through-hole and surface-mount components.

The unit is somewhat like an erector set in that many different tips and attachments can be interchanged to perform any soldering or desoldering task. All tips are sensor-driven so that the unit can display the actual tip temperature.

The SMD-250's thermal quad-pack tweezer with interchangeable tips allows the quick removal of all kinds of surface-mount devices. The tweezer handle is basically two soldering irons joined at a hinge that allows a surface mount device to be grabbed, heated, and removed from the board with one hand. Tips for the tweezer handle range from simple chopstick-like ones that can grasp a surface-mount capacitor or resistor, to square-shaped tips of different sizes that can slip over a PLCC (plastic leaded chip carrier). The tips tighten when the handle is squeezed, and heat all the pins at once—the part then lifts right off the board. Precise temperature control targets the heat to the leads without damaging the part or the board.

A static-dissipative solder extractor can remove solder from leaded components. The solder extractor is basically a soldering iron with a hollow tip. The tip is pressed over the end of a lead on the solder side of a PC board. Once the solder melts, the user can press a trigger that activates a vacuum pump within the SMD-250. That sucks the solder out of the joint, freeing the lead. The procedure must be repeated for each pin of a conventional IC before the part can be removed. The solder extractor can be used to remove any type of leaded component from a PC board. The sensitive tip responds to changes in temperature quickly, even when it is used on multilayer boards.

The SMD-250 also contains a high-efficiency lightweight soldering iron for use with both through-hole and surface-mount applications. The iron is temperature-controlled. A variety of interchangeable tips are included with the iron.

The SMD-250 also has a built-in epoxy/solder paste dispenser that can apply consistent deposits of the paste. Paste is pumped out of a dis-

Continued on page 92

New device turns any electrical outlet into a phone jack

ngineering breakthrough gives you unlimited hone extensions without wires or xpensive installation fees

By Charles Anton

You don't have to have a teenager to appreciate having extra phone jacks. Almost everyone wishes they had more phone jacks around the house.

When I decided to put an office in my home, I called the phone company to find out how much it would cost to add extra phone jacks. Would you believe it was $158?

No more excuses. Today, there are a thousand reasons to get an extra phone jack and a thousand excuses not to get one. Now an engineering breakthrough allows you to add a jack anywhere you have an electrical outlet. Without the hassle. Without the expense. And without the miles of wires.

Like plugging in an appliance. Now you can add extensions with a remarkable new device called the Wireless Phone Jack. It allows you to convert your phone signal into an FM signal and then broadcast it over your home's existing electrical wiring.

Just plug the transmitter into a phone jack and an electrical outlet. You can then insert a receiver into any outlet anywhere in your house. You'll be able to move your phone to rooms or areas that have never had jacks before.

Clear reception at any distance. The Wireless Phone Jack uses your home's existing electrical wiring to transmit signals. This gives you sound quality that far exceeds cordless phones. It even exceeds the quality of previous devices. In fact, the Wireless Phone Jack has ten times the power of its predecessor.

Your range extends as far as you have electrical outlets: five feet or five hundred feet. If you have an outlet, you can turn it into a phone jack—no matter how far away it is. The Wireless Phone Jack's advanced companding noise reduction features guarantee you crystal-clear reception throughout even the largest home.

Privacy guarantee. You can use The Wireless Phone Jack in any electrical outlet in or around your home, even if it's on a different circuit than the transmitter. Each Wireless Phone Jack uses one of 65,000 different security codes. You can be assured that only your receiver will be able to pick up transmissions from your transmitter.

Is the Wireless Phone Jack right for you?

The Wireless Phone Jack works with any single-line phone device. Almost anyone could use it, especially if...

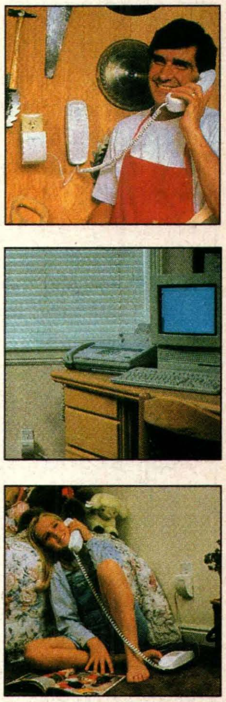
- **Few jacks.** *You want more phone extensions without the hassle and expense of calling the phone company.*
- **Bad location.** *You have jacks, but not where you need them most, like in the kitchen, garage, home office or outside on the deck.*
- **Renting.** *You want to add extensions, but you don't want to pay each time you move.*
- **Other phone devices.** *You have an answering machine, modem or fax machine you want to move to a more convenient place.*

The Wireless Phone Jack System consists of a transmitter (right) and a receiver (left). One transmitter will operate an unlimited number of receivers.

Unlimited extensions—no monthly charge. Most phone lines can only handle up to five extensions with regular phone jacks. Not with the Wireless Phone Jack. All you need is one transmitter, and you can add as many receivers as you want. Six, ten, there's no limit. And with the Wireless Phone Jack, you'll never get a monthly charge for the extra receivers.

Works with any phone device. This breakthrough technology will fulfill all of your single-line phone needs. It has a special digital interface for use with your fax machine or modem. You can even use it with your answering machine just by plugging it into the Wireless Phone Jack receiver.

Special factory-direct offer. To introduce this new technology, we are offering a special factory-direct package. For a limited time, the transmitter is only $49. One transmitter works an unlimited number of receivers priced at $49 for the first one and $39 for each additional receiver. Plus, with any Wireless Phone Jack purchase, we'll throw in a phone card with 30 minutes of long distance (a $30 value) for only $9.95!



The Wireless Phone Jack lets you add a phone, modem, fax machine or answering machine almost anywhere.

Try it risk-free. The Wireless Phone Jack is backed by Comtrad's exclusive 30-day risk-free home trial. If you're not completely satisfied, return it for a full "No Questions Asked" refund. It is also backed by a one-year manufacturer's limited warranty. Most orders are processed within 72 hours and shipped UPS.

Wireless Phone Jack transmitter ...$49 $4 S&H
Wireless Phone Jack receiver ....$49 $4 S&H
save $10 on each additional receiver—$39

30-minute long distance phone card.......~~$30~~
$9.95 with Wireless Phone Jack purchase

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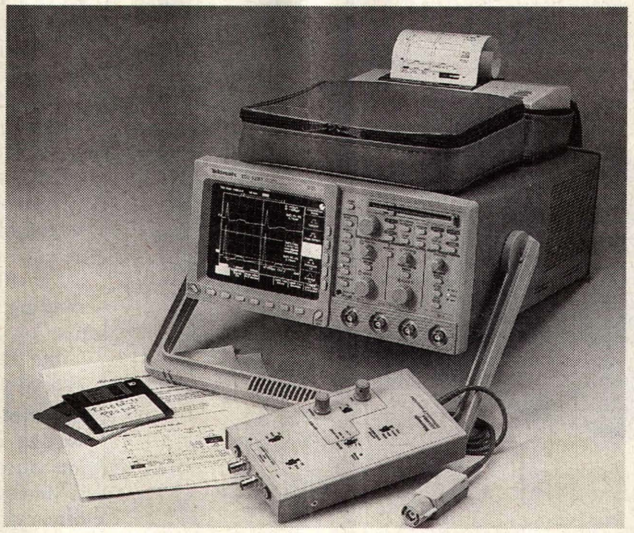
PERSONAL LAB SCOPES. The TDS 400A series of three digitizing storage oscilloscopes from Tektronix offer operating bandwidths from 200 to 400 MHz and sampling rates from 2.5 samples per second to 100 megasamples per second. The oscilloscopes are capable of making the electrical and physical measurements required for a range of applications from biophysical research, medical research, and mechanical analysis to high-voltage equipment.



CIRCLE 20 ON FREE INFORMATION CARD

Signal conditioning with 1.5 % accuracy is offered. An extended record length of 120 kilobits per channel allows researchers to capture hours of complex, slow-varying waveforms. When teamed with the ADA400A differential preamplifier, the instruments' 10-microvolt sensitivity can analyze extremely small amplitude signals. A HiRes mode extends vertical dynamic resolution to 12 bits, even on its single-shot signals.

Both TDS400A instruments feature an easy-to-use graphical user interface (GUI) and waveform zoom functions for efficient handling, viewing, and management of complex waveform data. The GUI and 25 automatic measurements are standard. A Fast Fourier Transform (FFT)/math option permits the harmonic analysis of signals in the frequency domain. An optional floppy-disk drive permits data and waveforms to be saved for further processing to document the results of acquired measurements.

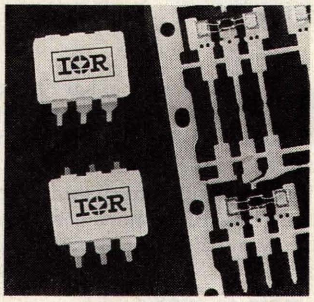
Specialized signal-conditioning accessories supplement the personal lab scopes' capabilities. The ADA400A differential preamplifier makes 10-microvolt sensitivity possible and the P5200 high-voltage differential probe permits a TDS 400A to make safe and accurate measurements at voltage levels up to 1300 volts.

The TDS 410A two-channel model has a base price of $4950. There are two four-channel models: the 200-MHz TDS 420A has a base price of $6295, and the 400-MHz TDS 460A has a base price of $7685. The ADA 400A differential input preamplifier is priced at $895, and the P5200 high-voltage differential probe is priced at $399.

TEKTRONIX MEASUREMENT BUSINESS
Literature Distribution Center
P. O. Box 1520
Pittsfield, MA 01202
Phone: 1-800-426-2200

PHOTOVOLTAIC RELAY. The PVT412 Series of photovoltaic relays from International Rectifier are single-pole, normally open, solid-state relays that can replace electromechanical relays in many applications. Each includes a power MOSFET (HEXFET) output switch, driven by an integrated circuit photovoltaic generator. The output switch is controlled by radiation from a GaAlAs light-emitting diode, which is optically isolated from the photovoltaic generator.

The relays, intended for telecommunications applications, are designed for on-off hook switching, dial pulsing, ringer injection, and general switching. For example, the PVT412L includes an active, current-limiting circuit conforming to FCC Part 68 and other regulatory agency current-surge requirements when overvoltage protection is provided. The PVT412 does not include current-limiting circuitry, but offers lower on-state resistance. The relays permit ±400-volt AC peak or DC switching at up to 140 milliamperes in AC mode and 210 milliamperes in DC mode.



CIRCLE 21 ON FREE INFORMATION CARD

Series PVT412 relays are packaged in six-pin, molded DIP packages with either thru-hole or "gull-wing" surface-mount terminals. They are available in standard (50-count) plastic shipping tubes or on tape-and-reel, priced at $1.40 each in 25,000 quantities.

International Rectifier
233 Kansas Street
El Segundo, CA 90245
Phone: 831-322-3331
Fax: 310-322-3332

10-BIT WIDE BIDIRECTIONAL OPTICAL LINK. The Optobus optical link from Motorola is a 10-bit wide bidirectional data interconnect assembly that will link computer systems over distances of up to 30 meters. The optical link

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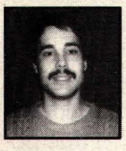

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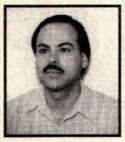
"CIE was recommended to me by my boss. It was appealing since I could study at my own pace at home and during business travel."
Dan Parks
Marketing Manager/Consumer Products
Analog Devices, Inc.



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Britt A. Hanks
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Petroleum Helicopters, Inc.

"I liked the way the school was set up with laboratory assignments to enforce conceptual learning. The thing which impressed me the most about CIE's curriculum is the way they show application for all the theory that is presented."
Daniel N. Parkman
Missile Electro-Mechanical Technician
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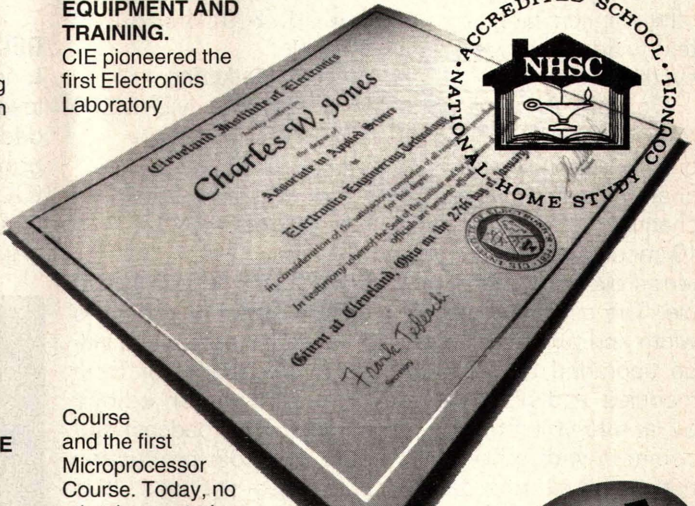

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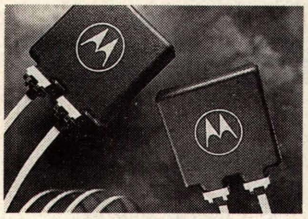


CIRCLE 22 ON FREE INFORMATION CARD

consists of two identical transmitter and receiver modules at the ends of a pair of connector-terminated and detachable 10-fiber ribbon cables. Optobus can transfer parallel data at 1.5-billion bits per second (1.5 Gb/s) in each direction, making it suitable for the higher transfer rates offered by the latest image, text, video, and voice data systems.

Optobus offers a data-transfer rate of 150 megabits per second (MB/s) per channel and provides 20 channels—10 transmit and 10 receive. Data is transferred over fiber ribbon cable. The assembly's bandwidth and functionality can be upgraded by replacing modules, and it is powered by a five-volt supply. In common with other fiber-optic systems, the data is secure and not affected by EMI and RFI.

The two transmitter and receiver subsystems share a common substrate, but they do not share a common power or ground. The module uses a form of low-voltage differential I/O (current-mode logic). The transmitter subsection consists of 10 differential electrical inputs and 10 optical output channels, which the order is reversed in the receiver subsection.

The optical interface of each module consists of a waveguide unit combined with an optical connector (MT) and 10-channel fiber ribbon. The transceiver module contains 10 laser-diode output ports, and the laser wavelength is nominally 850 nanometers.

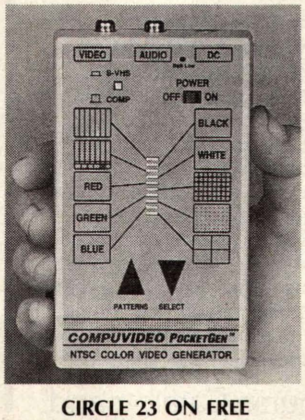
Applications for Optobus are seen in high-performance PCs, workstations, multimedia environments, parallel computers, high-end graphics, and video systems including interactive video.

An Optobus evaluation kit containing an evaluation board, one bidirectional module, one fiber-optic ribbon cable, and complete documentation is priced at $1500. Sample Optobus links consisting of two bidirectional modules and 10 meters of bidirectional fiber cable are priced at $5000, with discounts available.

Optobus Marketing
Motorola, Inc., MD M526
2200 West Broadway
Mesa, AZ 85202
Phone: 602-655-2967
Fax: 602-655-5020

COMPOSITE VIDEO/AUDIO GENERATOR. PocketGen is a handheld, composite video/audio generator from Compuvideo for editing studios, TV broadcast studios and post-production and video services. It is available in either NTSC or PAL versions.

The video/audio generator provides 10 patterns, including full field bars, SMPTE bars, rasters (red, green, blue, white, and black), crosshatching, dots, and center crosses. It can record SMPTE color bars with a tone at the beginning of a tape, and is switchable to black burst for blacking tapes. PocketGen will also "genlock" video equipment with a black burst. It can operate for more than 40 hours on four AA batteries, or be powered from the wall-outlet AC adapter included.



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The PocketGen video/audio generator is priced at $399.00

Compuvideo, Inc.
3861 Oceanview Avenue
Brooklyn, NY 11224
Phone: 718-714-9873
Fax: 718-267-0234

GUI DESIGNER. DOS Buttons from Annabooks allows designers of embedded systems to create a graphical user interface (GUI) for DOS applications that works with any pointing device, such as a mouse, pen, or touch screen. A custom GUI can be designed on a personal computer with the program's built-in toolsets. It is possible to create labeled pushbuttons of any size in a range of colors. They can have single- or dual-positions, and they can be in arrays or alone.

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DOS BUTTONS

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Each button can activate functions when pressed or released, or it can bring up windows containing more buttons. The designer can create on-screen calculators and keyboards or groups of latching pushbuttons that disable one button when another has been selected.

Analog bars can be created for either input or output data. To input data, the user points to the graduations on the bar, and the indicator moves to that position to show the value at the bottom of the bar. The value can be interpolated between the preset lower and upper values labeled on the bar. When transmitting data, the bar shows the selected position, and the data value appears at the bottom.

DOS Buttons also includes simple drawing tools. Several type fonts can be used to format the screens and windows, label the buttons and bars, and group similar buttons together under a common label.

DOS Buttons with its source code is on disk. With a manual it is priced at $249.00. The run-time royalty is $1.00 and the first 100 licenses are included in the purchase price.

Annabooks
11848 Bernardo Plaza Court
Suite 110
San Diego, CA 92128
Phone: 619-673-0870 or 800-642-1042
Fax: 619-673-1432

ELECTROMAGNETIC FIELD METER. The FieldProbe PY-17 is a new handheld electromagnetic field meter from Amprobe Instrument. It will measure 60-Hz electromagnetic field radiation generated by transformers, power lines, electrical distribution equipment, home appliances, and other sources.

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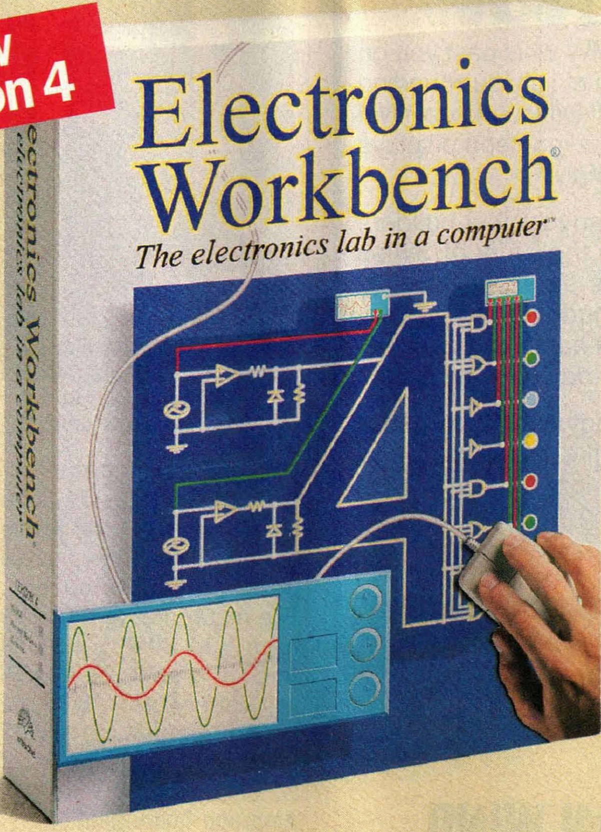
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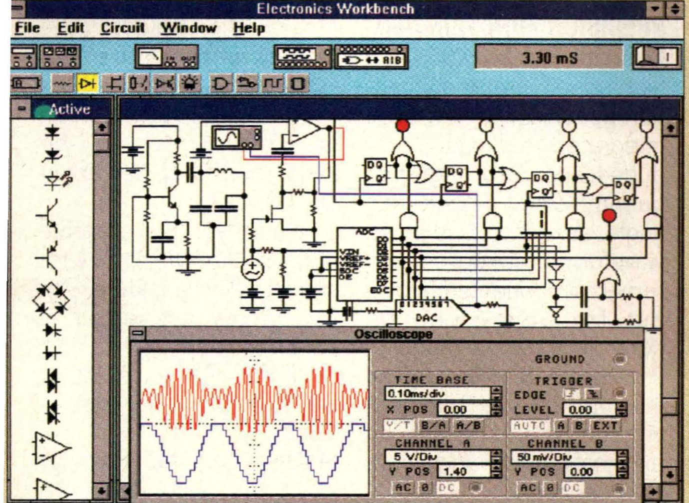
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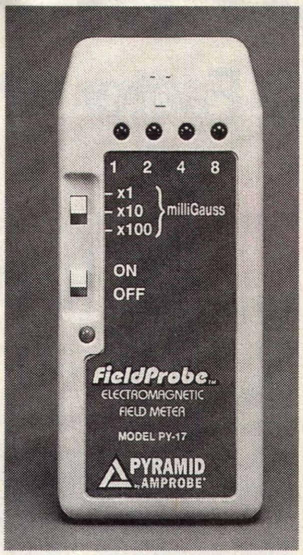


CIRCLE 25 ON FREE INFORMATION CARD

ject that generates electromagnetic fields, the PY-17 displays EMF levels to determine if they pose a potential health hazard. The meter measures fields from 1 to 800 milliGauss (mG). It is powered by a 9-volt battery (not included).

The *FieldProbe PY-17* EMF meter has price of $29.85.

Amprobe Instrument
630 Merrick Road
P. O. Box 329
Lynbrook, NY 11563
Phone: 516-593-5600 or 800-477-VOLT
Fax: 516-593-5682

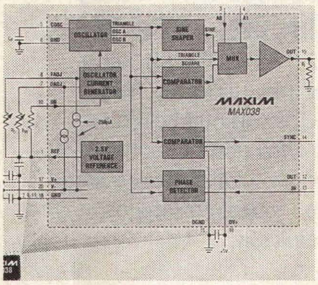
PRECISION FUNCTION GENERATOR. The MAX038 is a high-speed, precision function generator from Maxim Integrated Products. It produces accurate, high-frequency sine, square, triangle, sawtooth, and pulse waveforms with several external components. Its output frequency can be controlled over a range of 0.1 Hz to 20 MHz by an internal 2.5-volt bandgap voltage reference and an external resistor and a suitable capacitor.

The duty cycle of the output signal can be varied over a wide range by applying a ±2.3-volt control signal. This permits pulse-width modulation (PWM) and the generation of sawtooth waveforms.

Frequency modulation and frequency sweeping are achieved in the same way. The duty cycle and frequency controls are independent of each other.

Sine, square, or triangle waveforms can be selected at the output by setting the appropriate two-bit digital code at two TTL-compatible select pins.

The output signal for all waveforms is a 2-volt peak-to-peak signal that is symmetrical around ground. The low-impedance output can drive up to ± 20 milliamperes.



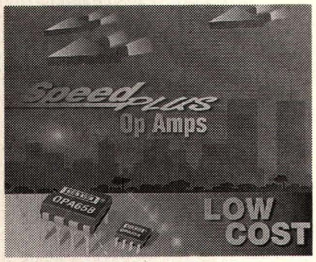
CIRCLE 26 ON FREE INFORMATION CARD

The TTL-compatible sync output from the internal oscillator maintains a 50% duty cycle—regardless of the duty cycle of the other waveforms—to synchronize other devices in the system. An internal phase detector allows the oscillator to be synchronized to an external TTL clock.

The MAX038 is available in a 20-pin DIP or wide-small outline package with two temperature ranges: 0 to 70°C and −40°C to +85°C). Prices start at $9.50 each in quantities of 1000.

Maxim Integrated Products
120 San Gabriel Drive
Sunnyvale, CA 94086
Phone: 800-998-8800 or 408-737-7600, extension 6087

HIGH-SPEED, LOW-POWER OP-AMP. The OPA658 is a new ultra-wideband, low-power, current-feedback operational amplifier from Burr-Brown. It features a high slew rate and low differential gain/phase error. Its low (50-milliwatt) power dissipation combined with its high (900-MHz) bandwidth make the device suitable for video, medical imaging, communications, and digital-to-analog conversion applications.



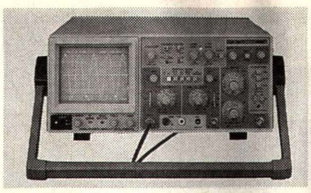
CIRCLE 27 ON FREE INFORMATION CARD

The current feedback of the OPA658 allows large signal bandwidth at high gains. Internally compensated for unity-gain stability, it operates from a ±5-volt power supply. It is packaged in eight-pin DIP and SOIC cases.

The OPA658 operational amplifier is priced at $2.25 each in quantities of 1000.

Burr-Brown Corporation
P. O. Box 11400
Tucson, AZ 85734
Phone: 800-548-6132

DUAL TIME-BASE OSCILLOSCOPE. The Model 2260 oscilloscope from B+K Precision has a 60-MHz bandwidth and 1-millivolt per division vertical sensitivity. V-mode triggering permits viewing two signals unrelated in frequency. Other features are main and delayed time bases and a built-in component tester for checking resistors, capacitors, coils, diodes, and other semiconductor devices.



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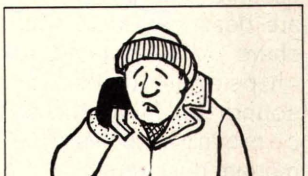
The oscilloscope's digital readout displays volts per division (either channel), seconds per division, and important operating mode information. Cursors can be set for measuring voltage and time differences and frequency.

There are 23 user-selectable calibrated sweep time ranges on the main timebase and 19 user-selectable calibrated ranges on the delayed-sweep timebase. Each sweep time range is fully adjustable between calibrated ranges. A times 10 magnifier allows closer examination of waveforms without disturbing the oscilloscope's display calibration.

The 2260 dual time-base oscilloscope with two 10:1 probes, instruction manual, and schematic diagram is priced at $1399.00.

B+K Precision
6470 West Cortland Street
Chicago, IL 60635
Phone: 312-889-1448 Ω



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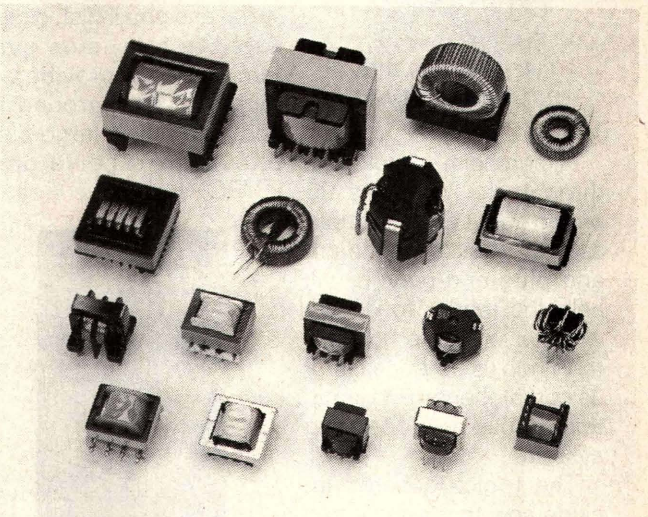

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NEW LITERATURE

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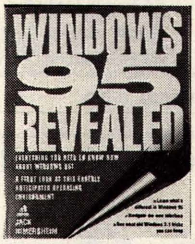
Windows 95 Revealed; by Jack Nimersheim. Random House Electronic Publishing, 201 East 50th Street, New York, NY 10022; Phone: 800-733-3000; CompuServe: GO RANDOM; $19.00

Microsoft's Windows 95 differs significantly from its predecessor Windows 3.1. It has a radically new interface design, and it handles DOS differently. nevertheless, many new features to help Windows users work more effectively with their personal computers.



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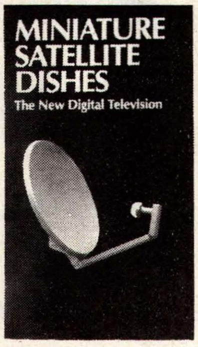
Nimersheim's book cuts through the Windows 95 promo about such subjects as the 32-bit environment and plug-and-play. It will help the reader to decide whether or not to upgrade to Windows 95 because of its comprehensive information on this new operating system.

The topics covered include how to: navigate and configure the user interface; use the new folders feature to hold documents and applications; set up peripherals, such as printers and modems; and install popular software programs in computers.

The book also explains how to use the Explorer, the improved version of Windows 3.1's File Manager. It explains how to access DOS (and why it's still necessary). And the reader will learn how to access frequently used files and programs rapidly with shortcuts and time-saving tips.

Miniature Satellite Dishes: The New Digital Television; by Dr. Frank Baylin. Baylin Publications, 1905 Mariposa, Boulder, CO 80302; Phone: 303-449-4551; Fax: 303-939-8720; $20.00 plus $4.00 S&H.

The introduction of high-power, direct-broadcast satellites (DBS) has made possible reception with miniature parabolic-dish antennas only 18 inches in diameter. This book gives the fundamentals of both large- and small-dish digital satellite television systems, and it provides a technical background in both DBS and large-dish television receive only (TVRO) systems.



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The author explains how both systems work, how to install them, and how to upgrade TVROs to dual-band, DBS/TVRO receiving systems economically. The book lists major component, system, and satellite manufacturers and includes descriptions of their products, stystems, and available services.

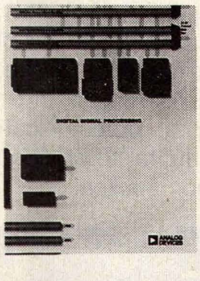
Competing programming packages are compared and their security encryption systems are explained. The book also describes how to connect DBS to existing home-entertainment systems. The text is accompanied by detailed circuit diagrams for connecting DBS television receivers and video cassette recorders. The author also forecasts the future of satellite TV.

Digital Signal Processing Brochure (Publication Number G1633a). Analog Devices, Inc., DSP Market Development, Norwood, MA 02062; 24 pages; Phone: 617-461-3881; Fax: 617-821-4273; free.

Analog Devices' latest fixed- and floating-point DSPs (digital signal processors) and 16-bit codecs are described in this brochure. Also included are chipset solutions for sound, fax/modem, and combination sound/modem designs.

An overview of DSP architectures includes the new SHARC (Super Harvard ARchitecture Computer) DSP with a 4-megabit on-chip SRAM and "glueless" interface for multiprocessors. A second member of the SHARC family offers 2 megabits of memory.

The brochure includes an overview of the company's software and hardware tools for application development. They include GNU C compilers and C debuggers; FFT benchmarks are provided to measure performance for routing DSP functions. Mixed-signal processors with DSP, codec, and all data and program memory on a single IC are discussed.



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Mastering Laser Printer Repair; by Don Thompson. Diversified TechniGraphics, Inc., 6 Morgan, Suite 112, Irvine, CA 92718; Phone: 1-800-457-5776 or 714-855-3838; Fax: 714-855-3959; $395 plus $10.00 S&H (U.S.).

This book will help technicians at all experience levels diagnose and fix laser printers. It covers such popular products based on Canon printer engines as Hewlett-Packard LaserJets and Apple LaserWriters.

Mastering
Laser Printer
Service

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Thompson's book begins with an overview of laser printers and discusses their principles and technology. It then explains why servicing them can be profitable, and how to start and expand a laser-printer service company.

With the Canon SX engine as a model, the other printers are compared. The book discusses faults that are common to the four most popular Canon printer engines. The frequency of occurance of those faults is explained with probability charts.

One chapter covers print defects. Each page gives an example of a defect accompanied by explanations of its cause and cure. Preventative maintenance procedures are discussed and service procedures developed by experienced professionals are presented. The basic electrical and mechanical troubleshooting techniques are given.

The Robotics Practitioner: The Journal for Robot Builders. Footfalls Ltd., 483 South Kirkwood Road, Suite 130, Kirkwood, MO 63122; E-mail: TRP$AKFootfalls.com; special first-year (four-issue) subscription rate for Electronics Now readers: $29.00

This new quarterly magazine will cover the design, development, and performance of robots, with its focus on the robot hobbyist, students, educators and inventors.

The contributed articles will be written by robot builders about their projects. They will cover the wide variety of software and hardware issues raised in robotics technology. Construction articles will take readers step-by-step though the construction of working robots designed to be built from readily available components.

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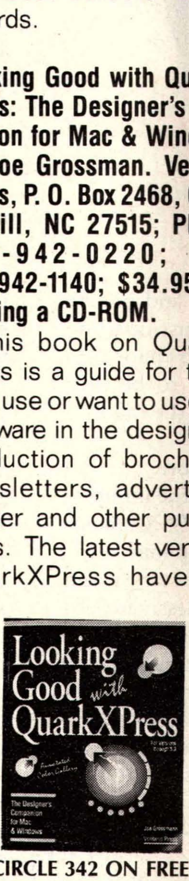
Regular columns will list robot clubs, provide a calendar of robot events, and give electronic addresses for robot builders' bulletin boards.

Looking Good with QuarkXPress: The Designer's Companion for Mac & Windows; by Joe Grossman. Ventana Press, P. O. Box 2468, Chapel Hill, NC 27515; Phone: 919-942-0220; Fax: 919-942-1140; $34.95, including a CD-ROM.

This book on QuarkXPress is a guide for those who use or want to use that software in the design and production of brochures, newsletters, advertising matter and other publications. The latest versions QuarkXPress have corrected the interface quirks in the original software that made it difficult to use.


Looking Good with QuarkXPress
The Designer's Companion for Mac & Windows
Joe Grossman

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To help readers take advantage of QuarkXPress' array of tools, this book contains illustrations, backed-up by practical advice and insider tips. Coverage includes a brief overview of the tools, techniques, basic design concepts, and the design development process.

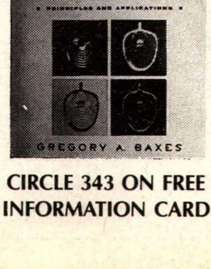
The reader will learn how to use dialog boxes and palettes to create page designs, headlines, photo arrangements, and color effects. Actual XPress creations, including 40 pages of color examples, are analyzed.

The companion CD-ROM disk contains 45 design templates that serve as models for the readers' page designs. Included are backgrounds, special picture boxes, fonts, and clip art.

Digital Image Processing: Principles and Applications; by Gregory A. Baxes. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; Phone: 1-800-CALL-WILEY; $39.95, including an instructional floppy disk.

This book discusses the principals and applications of digital image processing at a level that will be comprehensible to a wide range of readers. Baxes has written in clear, jargon-free language to attract those readers who have a need to know but may have neither the time nor opportunity to take a formal course in the subject.

Step-by-step lessons are given in digital image processing principles, techniques, and technologies. The author provides detailed explanations of the most commonly used digital image-processing operations.



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The book also includes a comprehensive listing of available hardware, and an explanation of the best methods for acquiring, displaying, and processing digital images. The text is backed-up by a digital image-processing program on a floppy disk that is included with the book.

PC Instrumentation and Data Acquisition Catalog. Global Specialties, 70 Fulton Terrace, New Haven, CT 06512; Phone: 800-572-1028; Fax: 203-468-0060; 16 pages; free.

This is Global Specialties latest catalog on personal computer instrumentation and data acquisition products. It includes virtual instruments on a card and analog and digital I/O cards for IBM-PC or compatible personal computers.

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The plug-in boards include A/D combination cards, opto-isolated Darlington output cards, a 48-channel PIO card, a thermocouple input card, and two virtual instrument boards.

The virtual instruments include those for simulating a digital multimeter with chart recording and data-logging functions, and a combination function generator, pulse generator, waveform generator, and universal counter-timer. Each virtual instrument includes the card and a software graphics package. Ω

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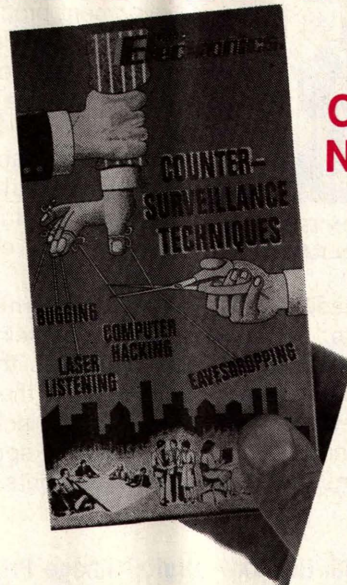

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Bugs of a very small size are easy t build and they can be placed quickly in matter of seconds, in any object or room Today you may have used a telephon handset that was bugged. It probabl contained three bugs. One was a phon bug to fool you into believing you found bug and secured the telephone. The sec ond bug placates the investigator wher he finds the real thing! And the third bu is found only by the professional, wh continued to search just in case there wer more bugs.

The professional is not without hi tools. Special equipment has been designed so that the professional can swee a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operate by novices, others require a trained countersurveillance professional.

The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may very well consider a career as a countersurveillance professional.

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COMPUTER CONNECTIONS

Retreat of the barbarians.

JEFF HOLTZMAN

Growing up can be bittersweet. On one hand, you get to learn the truth concerning many things you were curious about. On the other, you do learn the truth.

Borland is the company that never grew up. Throughout the first decade of its existence, Borland prided itself on being different. It shunned traditional corporate culture. It emphasized product performance and originality. Based on an underlying faith in excellence, it thumbed its nose at hard-nosed business practices, preferring instead what it called a "barbarian" style of marketing.

Its barbarian style worked, for awhile. Throughout the 80's, when the computer industry was much more fragmented, when products with original ideas sprouted like weeds overnight—and often disappeared just as quickly—Borland was a mainstay in that environment. Turbo Pascal, SideKick, Turbo C, . . . then what?

There were brief flings with various products, including a Prolog development system, a text editing/formatting system, a massive upgrade of SideKick that substituted mere heft for magic, and an OS/2 version that went nowhere. (For you youngsters: SideKick was the original TSR and the original PIM (personal information manager); but Borland never even tried to make SideKick desirable to the PIM market. Yes, Borland did eventually (in the fall of '94) release a version of SideKick for Windows, but it was much too little, way too late. In fact, SideKick for Windows was one of the first products jettisoned in the company's recent reorganization.)

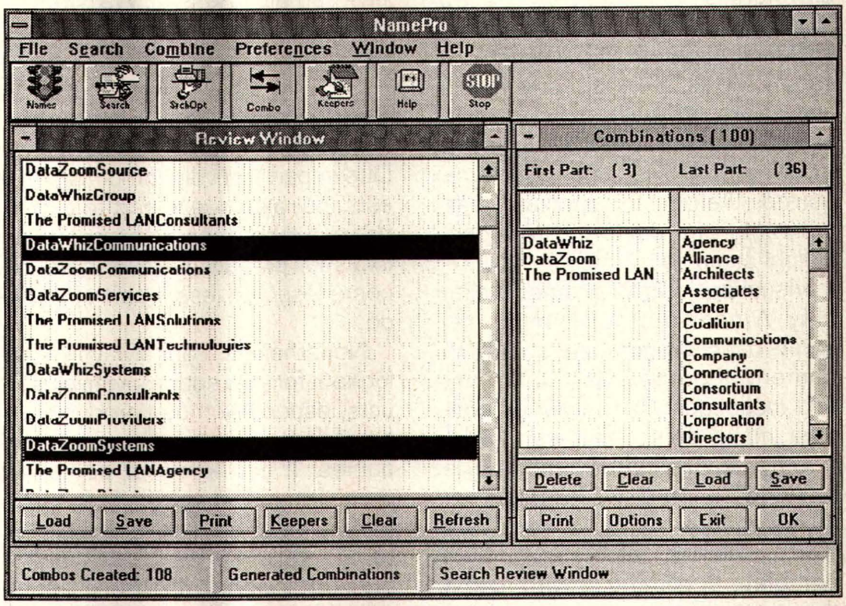

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FIG. 1—NAMEPRO helps create names for new products and companies using several databases and combinatorial techniques.

Then Borland bought Ashton-Tate, to gain control of dBase database software. dBase? Borland had already bought Paradox, considered technically superior to dBase. dBase had been in technical trouble at Ashton-Tate, and Borland quickly found out that resolving those difficulties was going to be difficult and time-consuming. The protracted period during which Borland fought to overcome those difficulties gave Microsoft a tremendous head-start in the just-emerging Windows market. Borland was taken off-guard by the success of Microsoft's Access database for Windows. Despite years of development, Microsoft had never even introduced its DOS-based database, known internally as Cirrus, which was eventually re-architected for Windows and released as Access. (The header of one appendix of the user manual for Access 1.0 actually refers to the product as Cirrus.)

Throughout that period, Borland was busy building fancy new office space and providing a musical outlet for saxophone-playing founder and charismatic chairman of the board, Philippe Kahn.

Hard-nosed business practices eventually caught up with Kahn. In early January of this year, he resigned his roles as President and CEO of Borland. Although he retains chairmanship, Gary Wetsel has assumed the roles of President and CEO. One of Wetsel's first actions was to lay off 40% of the company. That came on the heels of a decision by the board to divest Borland of its consumer product line, which consisted only of SideKick for Windows and a nice Windows shell originally written by Hewlett Packard called DashBoard.

The new Borland intends to focus on programming tools, including its C/C++ compilers, dBase and Paradox, and a new entry currently known as Delphi, expected for release around the time you read this. I find the C/C++ market rather ho-hum, but Delphi sounds hot.

The oracle and the barbarian

In many ways, Delphi represents Borland's last best hope for survival. Delphi reaches back to Borland's earliest roots in Pascal, but in an up-to-date, object-oriented visual development environment. Delphi is intended to be a Visual Basic (VB) killer. Delphi is intended to make up for many of VB's deficiencies.

Whereas VB is based on relatively slow technology that interprets an intermediate "p-code" at run-time, Delphi produces fully compiled applications. One reason for VB's immense popularity is its extensibility via what are called VBXs (Visual Basic Extensions). An entire subindustry now exists to supply VBXs of all sizes, shapes, and colors. Ironically, though, VB itself cannot be used to produce VBXs; a Windows C compiler is required. Delphi, by contrast, can create its own custom extensions. Delphi can also run VBXs.

Visual Basic, in its attempt to simplify Windows programming, restricts direct programmer access to numerous properties, functions, and messages; Delphi will by contrast make these features visible. Another feature worth mentioning is run-time support. Visual Basic requires a 400K dynamic link library (DLL), whereas Delphi can produce complete applications with everything bound into a single file.

Delphi is based on Pascal. There is no internationally sanctioned standard for Pascal; over the years, whatever Borland has done has defined a de facto, albeit single-sourced, standard. Delphi will do nothing to change that. In addition, from what I've heard so far, it appears that Delphi will have no cross-platform support. On the other hand, the Visual Basic language conforms to no standard either; nor is it available on any other platform.

Another issue is that there are lots of Basic programmers out there, and lots of C/C++ programmers. But Pascal programmers? Is Pascal still commercially viable? I love Pascal as a language. I find it infinitely more elegant than either Basic or C. But I know that's a minority opinion.

In the meantime, Microsoft has been working on version 4.0 of Visual Basic. The product was originally targeted for release early this year, but Microsoft seems to be holding off to coordinate its release with Chicago. That may give Borland a six-month lead, or it may force buyers to hold off for six months.

Can Borland survive? Can Delphi save Borland? I don't know, but I would hate for the industry to lose Borland—it needs more than one vendor of programming tools.

Growing up can be hard. But the mistakes of youth can make us stronger adults. Let's hope Borland has learned its lesson. We need barbarians to keep the big guys honest.

Product cameos

I used to review lots of products. Due in part to evolution of my interests, but also due in part to a slowdown in innovation in the computer industry, product reviews have become less and less a part of what I do.

Nonetheless, I am always on the lookout for new and innovative products, especially those produced by small, out-of-the-mainstream companies. If you know of computer products in this category that you believe other readers would find interesting, send me E-mail with a brief description of the product, what you find intriguing about it, and contact information. I'll see what I can do.

In that spirit, I'd like to discuss briefly one such product, NamePro, along with one very much in-the-mainstream product, Microsoft Office Professional & Bookshelf.

NamePro. How do you name a new product? There are two major tasks, one creative, the other administrative. The creative part involves coming up with a name that concisely expresses something about the nature of your product. The administrative part involves verifying that the name is not already in use.

NamePro can help in both regards. The creative part consists of several databases of words, along with an interactive Windows-based component that allows you to combine them in various ways, based on the connotation you'd like the name to have. The administrative part consists of a database of existing trademarked names against which you can compare candidate names.

For example, if you wanted to start a company dealing with networks and databases, you might find the following prebuilt names in NamePro's database: The Promised LAN, DataZoom, and DataWhiz. Then you could load a word-part database dealing with company names, and automatically combine them, in all permutations, with the prebuilt names, as shown in Fig. 1.

By itself, NamePro might or might not lead you to the perfect name. But its numerous databases and combinations can help you get into the right frame of mind.

Microsoft Office Professional & Bookshelf. Someday we will look back at this massive cantankerous lumbering collection of applications as, in the evolutionary sense, a dinosaur. But right now, it's the best dinosaur we've got, particularly Word for Windows and Access. And more and more new PCs come with this package preinstalled. I was curious to see how the integrated installation and documentation function. Let's say I wasn't overly impressed.

This "Office Suite with Integrated CD-ROM Library" comes on a pair of CD-ROMs. One contains all the programs (primarily Word, Excel, PowerPoint, and Access; a license (but not the code) for Microsoft Mail; and a set of mini-applications, some of which (e.g., a scanning utility and an organization chart utility) appear to be brand new but unadvertised. The other CD contains an extensive set of on-line documentation and BookShelf, a collection of reference works, including dictionary, thesaurus, encyclopedia, quotations, almanac, and more. Interesting points about the package:

- The basic package does not include printed documentation; if you want it, you must purchase a set of manuals separately for about $130.
- A complete installation of everything (less the BookShelf database and on-line documentation) requires only about 90 megabytes of disk space.
- The installation routine is buggy, as it repeatedly reports errors after installing some icons into Program Manager.
- An installation frustration is that it asks where you want to install files, and then proceeds to stick a nice little 12-megabyte chunk where *it* wants.
- The overall installation process is

awkward. You can't just set of bunch of options on a screen or two and go away. Instead, you're presented with dialog after dialog, redundant checks for available disk space, and other time wasters.

Once you get through the installation, everything pretty much works as advertised. The package also includes a couple of "always-on-top" button bars (to which you can add your own buttons) that keep you never more than a click away from any of the Office applications and Bookshelf references.

E-mail

My column on Conceptual Documentation is still generating responses. G. Lundy thoughtfully writes, "As an engineer who dreamt of being an engineer, not a technical writer, I drifted into the technical writing field, where I have seemingly been enslaved for the past ten years. . . . Each of six writers here is a degreed engineer (EE, ME, CS, other).

The common problem faced is not just a standard methodology for writing, but getting project managers to fit within the scope of their respective projects the need to plan document development in parallel with engineering. Far too often the document is the last thing to be scheduled. This leads to writing garbage-in-garbage-out-type technobabble, and rushing to put out anything that can meet the terms of the contract." Yup. I hear you. I've been there.

Also, for you die-hards out there, Chris Courson operates a free BBS that supports 8-bit computers and public domain software. The number is (813) 238-8076.

As always, comments are welcome. Send them to my Internet address jkh@acm.org. Ω

PRODUCTS DISCUSSED

- NamePro ($495), The NameStormers, 4347 West Northwest Highway, Suite 1040, Dallas, TX 75220-3864. (214) 350-6214.
- Microsoft Office Professional & Bookshelf, Microsoft Corporation, One Redmond Way, Redmond, WA 98052. (206) 882-8080.

WHAT'S NEWS

continued from page 4

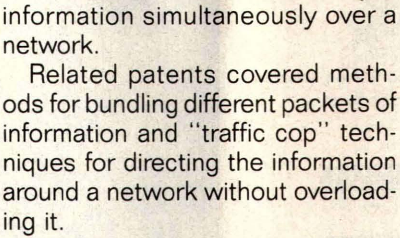
that a U.S.-based company topped the list.

Most of the IBM patents were in the field of information processing, but IBM continued to hold its lead in patenting software-related inventions. The patents issued include one for a method for encrypting and decrypting software on a CD-ROM. It allows a buyer to use only the software he has purchased and for which he has a software "key." The invention will allow several different software packages to be recorded and distributed on a single CD-ROM.

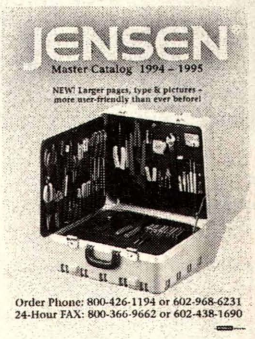
Patents also were issued for processes that make possible for the speedy and efficient transmission of multimedia data—audio, video, graphics, and text—over a network. The patented technology, called asynchronous transfer mode or ATM, allows computers to send and receive a combination of multimedia information simultaneously over a network.

Related patents covered methods for bundling different packets of information and "traffic cop" techniques for directing the information around a network without overloading it.

Another patent was issued for a high-quality semiconductor material production method that combines silicon with germanium. The material is intended to allow IBM to build super-fast transistors. Those transistors, which can be produced on existing wafer fabrication lines, could lead to improved consumer-electronics products, better medical equipment, and higher-speed computers. Ω



Fresh batteries, anyone?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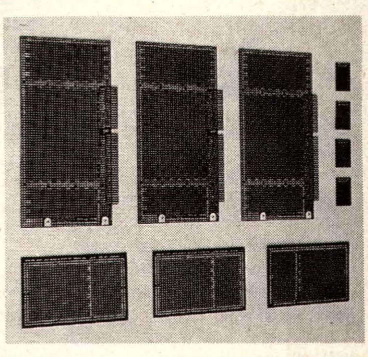

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EVERYONE WANTS TO SAVE MONEY, AND MOST people want to improve the well-being of our planet. Well, you can do both by simply using such energy-saving computer products as "green" PCs and other Energy Star peripherals.

Recent studies conducted by the Environmental Protection Agency (EPA) conclude that personal computer systems account for more than five percent of all electrical power consumption in the U.S. That consumption is increasing rapidly because home and office computer equipment has become the fastest growing segment of the consumer-electronics market. That booming growth not only threatens to increase energy costs, but also to damage the environment as power companies scramble to meet the need by building new facilities.

In an effort to stem this rising tide, Phoenix Technologies and Intel conceived of the concept of the "green" PC: one that draws little or no power when it is idle. The green concept was later expanded to include PC peripherals and energy-smart software. These energy-saving products cut energy consumption by switching the device to a low-power state when it is idle or not in use. As an added benefit, powering down these devices can often extend their life.

Even if you are not concerned about saving money or the planet, it's virtually impossible to avoid the green movement. Many PCs and peripherals sold today—which include everything from monitors to printers to modems—include energy-saving features.

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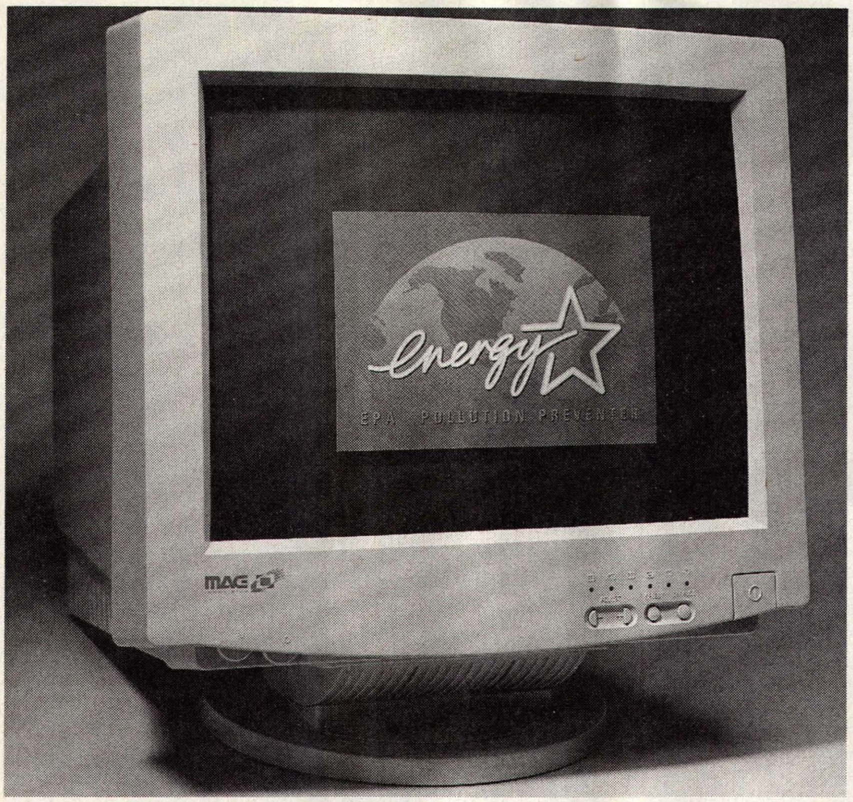


FIG. 1—ENERGY STAR IS A SELF-POLICING PROGRAM that lets the vendors test their own products for compliance. The EPA grants the Energy Star logo shown on the Mag Innovision screen above to PCs, monitors, and printers that use 30 watts or less when idle.

TABLE 1—ENERGY-SAVING RECOMMENDATIONS

	Normal	Standby	Suspend	Off
Energy Star	100%	Not defined	<30 watts	Not defined
NUTEK/TCO	100%	<30 watts; <15 watts recommended	<8 watts; <5watts recommended	<1 watt ultimate goal

Energy Star

In late 1992, the EPA proposed a set of power-management guidelines for energy-efficient computer equipment. The program, called Energy Star, is not a government mandate; therefore participation is not a requirement for computer and peripheral manufacturers.

Energy Star guidelines recognize two levels of operation: a full power mode and an inactive, or sleep, mode. To garner an Energy Star rating, a device cannot draw more than 30 watts of power when it is idle. However, Energy Star guidelines say nothing about the length of time the device has to be inactive before it powers down, or how the power-down is accomplished. All of those details are left up to the individual manufacturer.

Computer products that comply with the Energy Star guidelines are distinguished by an Energy Star logo (see Fig. 1) that the vendor can proudly display in advertisements, publications, and on the product itself. To encourage participation in the program, President Clinton issued an Executive Order on April 21, 1993, Earth Day, that directs all government agencies to purchase only equipment that meets the Energy Star guidelines.

NUTEK/TCO

Of course, Energy Star isn't the last word in energy conservation, and many consider the guidelines to be much too lenient. A stricter version comes from Sweden's Department of Energy Efficiency, NUTEK, which has teamed up with TCO, a trade union, to create an energy-saving standard known simply as NUTEK/TCO for use throughout Europe.

The NUTEK/TCO recommendation defines three power levels of operation: full power, automatic standby, and automatic power down (see Table 1). The automatic standby mode, the first step down from full power, limits power consumption to 30 watts (which matches Energy Star's recommendation) but suggests a 15-watt ceiling. The automatic power-down mode, for which there isn't an Energy Star equivalent, specifies 8 watts as the highest acceptable energy consumption level, with a desired figure of 5 watts or less. NUTEK/TCO's ultimate goal for power-down is 1-watt total power consumption, which would occur when everything but the power-controller circuit is turned off.

Both shut-down modes are activated by a timer. If no user or communications (modem or network) activity is detected within a period of five minutes to one hour (the length of the period determined by the user) the energy-saving gears are set into motion. Note, though, that the timers run concurrently. For example, if the standby mode is set to kick in at 30 minutes and the power down mode is set for 40 minutes, the device will reduce power to standby status in 30 minutes and go into the power down mode 10 minutes after that.

Green PCs

Although the concept of powering down idle devices seems simple enough, the process itself can get quite complex. In a green PC, the microprocessor or CPU, its associated chip set, and the BIOS (basic input/output system) are all involved. Basically, it's the job of the BIOS and chip set to monitor system activity and determine when it's appropriate to shut down the various subsystems. The priority of device shutdown depends on its power consumption and typical use cycle (see Fig. 2).

Processors

The microprocessor is a major power consumer. Pentium processors can draw up to 15 watts under full load, and the 80486DX2 can easily consume 5 watts, even while doing absolutely nothing. The amount of power a microprocessor consumes is directly proportional to its operating frequency, as described by the equation:

$$P = CV^2f$$

where C is the device's capacitance, V is the voltage difference between its high and low logic levels (1.6 volts for 5-volt logic, and 0.6 volts for 3.3-volt logic), and f is the clock frequency (see Table 2).

An obvious way to reduce power consumption is to slow down the microprocessor's clock speed. The speed of the clock can be dropped to 8 MHz during periods of inactivity for most 486 processors without adversely affecting system performance. Slowing the clock was a popular method of energy conservation a couple of years ago, but it has largely given way to suspend- and stop-clock power reduction. However, the microprocessor must be a static devicefor the stop-clock mode to work; that is, it must be able to retain its data even with the clock stalled. All Pentium and all 486 microprocessors (except those made by AMD) are static devices.

In most microprocessors, the suspend state is accomplished by stopping the clock to the bulk of the circuits, while keeping the memory, cache control, and external-bus control alive. A halt instruction causes all 486 and Pentium processors (except AMD's 5-volt 486 series) to enter their suspend states.

TABLE 2—MICROPROCESSOR POWER CONSUMPTION

Processor	Frequency	Power (W) active	Power (W) suspend	Power (W) stop clock
Intel Pentium	100	10.1	1.55	0.090
Cyrix Cx486DX2	66	6.6	0.17	0.005
AMD 486DXL2	80	7.5	1.17 (1)	n/a (2)
Intel 486DX2	50	5.7	0.45	0.100
Cyrix Cx486DX2-V	80	5.2	0.15	0.040
AMD 486DX4	100	5.0	0.14(1)	n/a(2)
Intel 486DX	33	4.5	0.50	0.010
Cyrix Cx486DX2-V	66	4.4	0.13	0.038
Intel 486DX4	100	4.3	0.33	0.003
Intel 486SX	33	3.2	0.40	0.010
Cyrix Cx486DX2-V	50	2.9	0.09	0.034

In the suspend mode, the microprocessor still responds to interprocessor and external snoop requests. For example, an interrupt request (INTR), non-maskable interrupt (NMI), or signal-managing interrupt (SMI) will terminate the suspend mode and bring the microprocessor back to full power.

In the clock-stop mode, clock signals to all microprocessor logic, except that needed to awaken the processor, are stopped. In this mode, power consumption is typically less than 1/10th watt; the clock is restored when the "clock-stop" reset line is strobed.

The mechanism normally used to control power management is system-management mode (SMM), a set of special instructions that was first available on Intel's SL processors. The SMM software, which is stored in a separate memory space called system-management RAM (SM-RAM), controls microprocessor power without requiring that the existing operating system be rewritten or modified.

Storing the system-management code at a specific memory address allows the SMM to operate without interrupting normal microprocessor operation or system memory. System-management code is entered via the signal-management hardware interrupt. An SMI signal is generated by any one of the many system interrupts that monitor for system activity or inactivity. When an SMI is detected, the processor saves its state to a fixed location within the SM-RAM, and then runs the SMM code. The code's message determines the level and depth of power management. Normal microprocessor operations are restored by entering an SMM instruction called Resume Normal Mode (RSM).

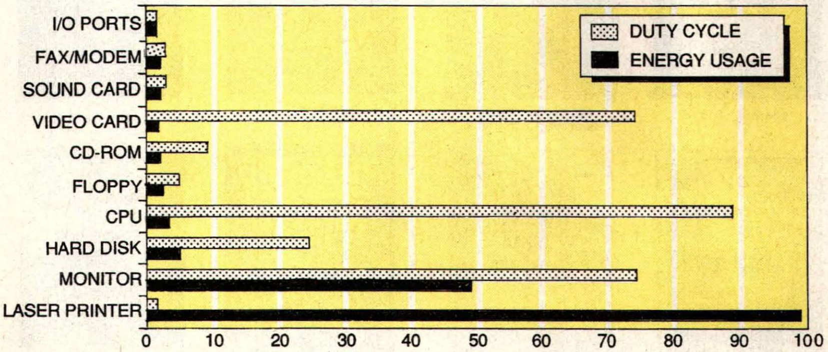
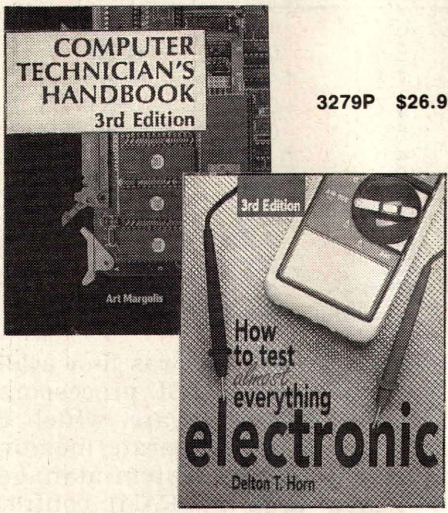


FIG. 2—WHILE IT'S ADVANTAGEOUS TO SHUT DOWN power hogs as quickly as possible, it's not always practical. As much power savings can be gained by paying close attention to spinning the hard disk up and down as to blanking the monitor.

Green chip sets and BIOS

If you think of the microprocessor as the muscle of a power-management system, then the chip set represents the nervous system, and the BIOS is the brains. The chip set is a collection of signaling devices that link the microprocessor to its peripherals. A green chip set must also provide the signals necessary to power-down and reactivate the microprocessor and peripherals. At the simplest level, a green chip set provides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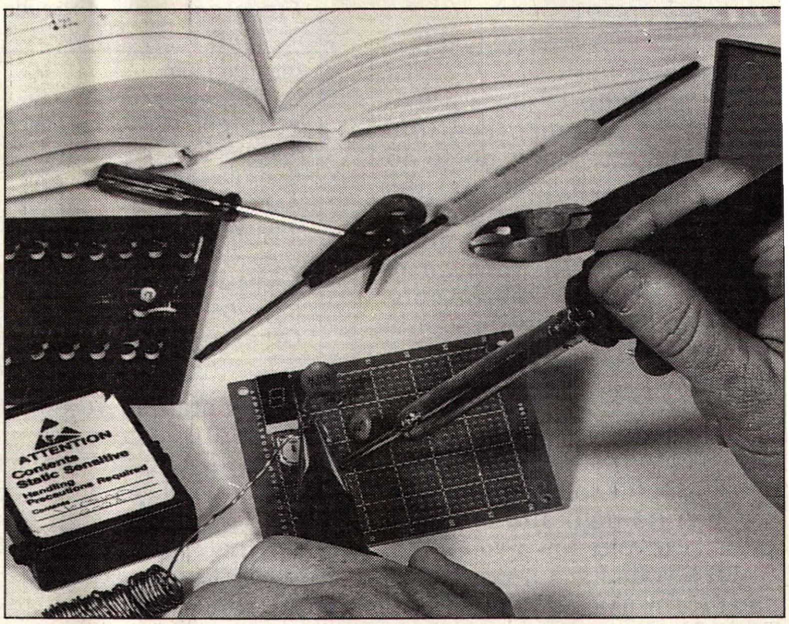
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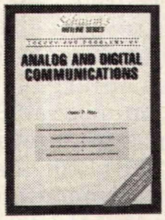
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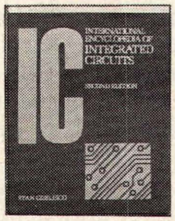
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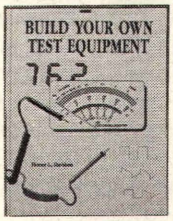
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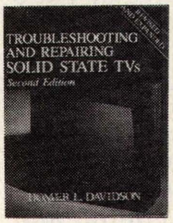
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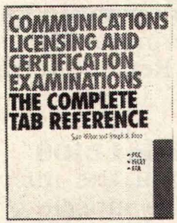
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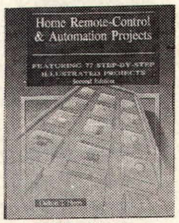
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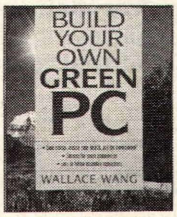
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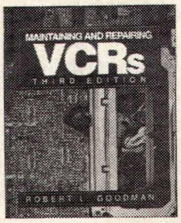
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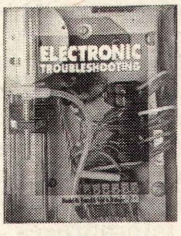
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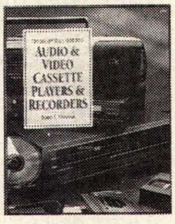
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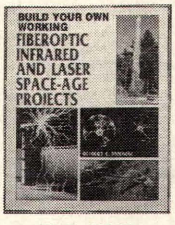
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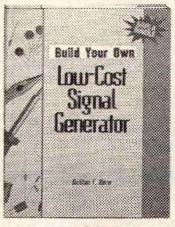
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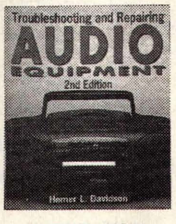
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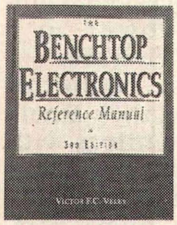
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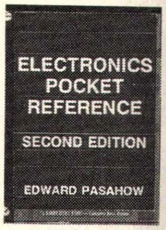
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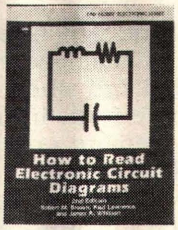
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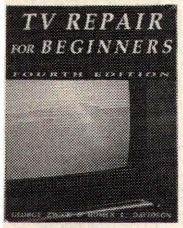
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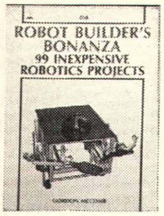
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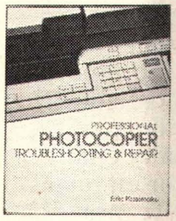
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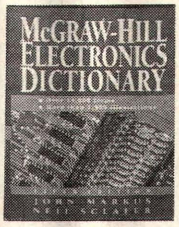
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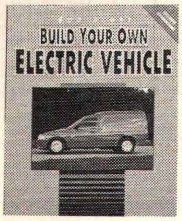
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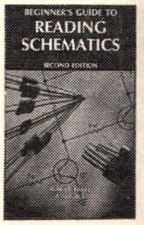
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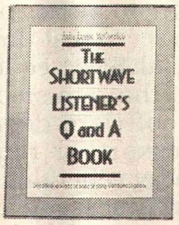
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TABLE 3—VESA MONITOR POWER STATES

	Normal	Standby	Suspend	Off
H-sync	On	Off	On	Off
V-sync	On	On	Off	Off
Power level	100%	80%	<30 watts	<8 watts
Mitsubishi Diamond Scan 17FS—power usage	106 watts	78 watts	10 watts	5 watts

SMI, stop-clock, and suspend power-management signals to the microprocessor. But virtually all green chip sets also include SMM support for Intel's SMI power-management scheme, and most support AMD's and Cyrix's power management routines.

All chip sets have one or more timers to monitor system activity and provide signal-management (or equivalent) interrupts as subsystems and peripherals time out. These interrupts trigger on the activity or inactivity of video, floppy- and hard-disk drives, I/O ports, keyboard, DMA (direct memory access), and system memory. The BIOS dictates when a timer will time out and generate an interrupt signal.

For example, consider the typical duty cycle of a hard-disk drive—the second largest energy consumer in a desktop PC. When the computer system is booted (started), the BIOS loads the hard-disk drive timer with a time-out value. That value may be user supplied or a system default, and typically ranges from 2 to 15 minutes. The chip set monitors the hard disk's activity, and resets the timer every time a read/write operation is performed. If a read or write isn't detected within the specified period, the timer times out, and the chip set generates an SMI, forcing the microprocessor to run the SMM code that shuts off power to the hard disk.

Advanced Power Management

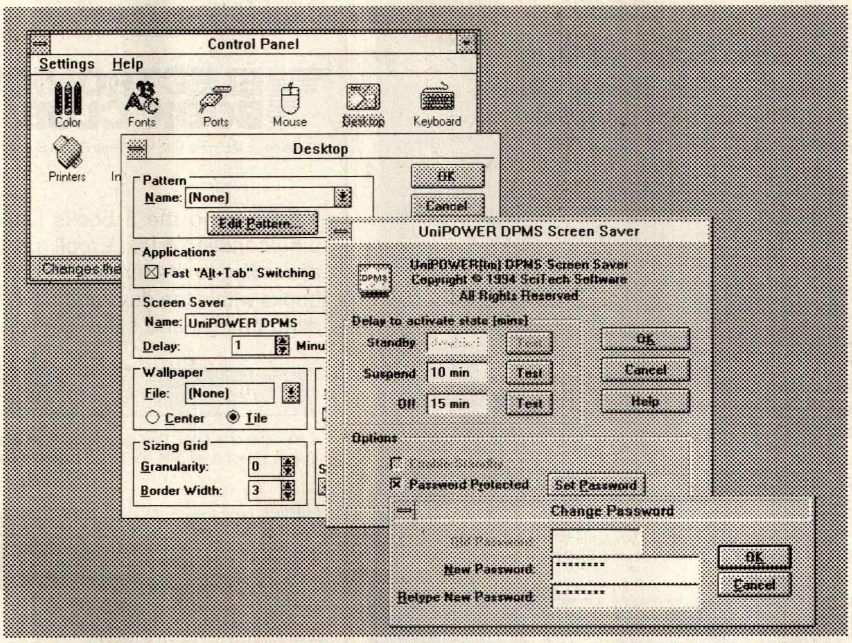
So far, only power management at the hardware level—where hardware timers determine the sequence of power-down events—has been discussed. However, greater power saving can be achieved if the software, which can determine exactly what components are needed and when, takes an active role in defining the power-management profile.

Advanced Power Management (APM) is a layered approach to software power management. It allows applications, operating systems, and the system BIOS to work together to reduce power consumption. As the program runs, it constantly feeds the BIOS with updated information, dynamically changing the system's power-management parameters to match those of the application. The BIOS, in turn, programs the chip set in real-time as it writes special SMM code to the SMRAM that's in step with changing software demands. When necessary or requested, the chip set generates an SMI to the microprocessor, causing it to enter SMM. Originally designed for use in notebook computers, the APM standard is finding widespread acceptance in green desktop computing. (See Advanced Power Management: Power-Saving Protocol for Mobile PCs for details.)

Monitors

It used to be that the motherboard was the biggest consumer of electric power in a computer system. That's no longer true because computer users are replacing their small-screen 14-inch monitors with large-screen 17-inch displays—which can consume 100 watts and more. That's about 50% more power than used by a typical 486SX multimedia PC system. That's why a lot of effort has gone into reducing monitor power consumption.

Buying a green monitor is only half the battle, however. Few monitors are smart enough to know when they're needed and when they're not. They have to be told when to be awake and when to go to sleep. There are no set rules on how to do this—each monitor manufacturer can create its own power-management scheme. At present, the two methods most commonly implemented are the Video Electronics Standards Association



Pattern
Name: (None)

Applications
☒ Fast "Alt+Tab" Switching

Screen Saver
Name: UniPOWER DPMS
Delay: 1 Minu

Wallpaper
File: (None)
○ Center ● Tile

Sizing Grid
Granularity: 0
Border Width: 3

UniPOWER(tm) DPMS Screen Saver
Copyright © 1994 SciTech Software
All Rights Reserved

Delay to activate state (mins)
Standby
Suspend 10 min
Off 15 min

Options
☐
☒ Password Protected

New Password: ********
Retype New Password: ********

FIG. 3—SPECIAL TSR SOFTWARE, like SciTech Software's UniVBE/Pro 5.0 shareware above, can make an ordinary VGA or superVGA video controller behave like an energy-saving DPMS controller. This program, named UNIVBE50.ZIP, can be found on the Gernsback BBS.

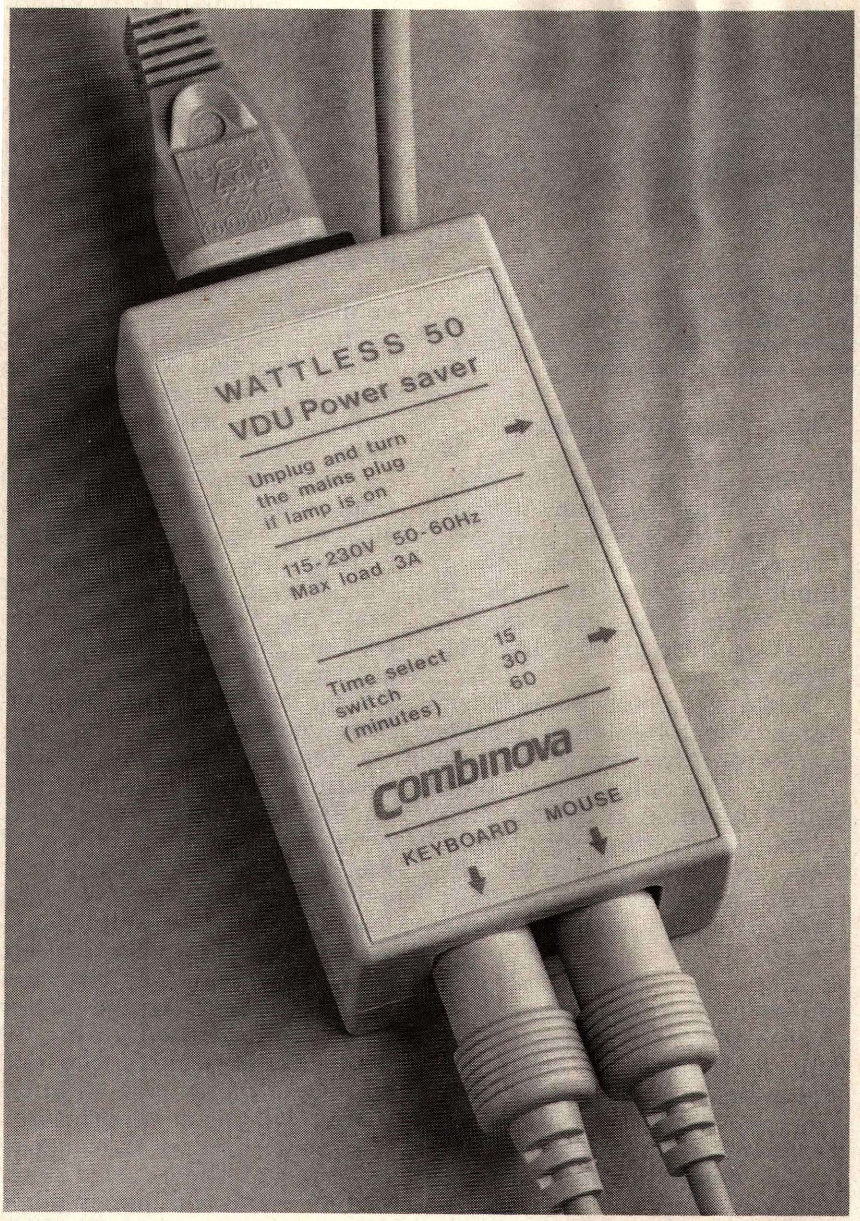


FIG. 4—TO INSTALL THE WATTLESS, unplug your keyboard, plug it into the Wattless, and then plug the Wattless keyboard cable into your PC. If you have a mouse, you can use a special cable with a bifurcated cord that allows you to plug it in as well.

(VESA) standard and video-blanking signaling.

The VESA Standard

The most popular method is the VESA standard, which incorporates a four-step program called display-power management signaling (DPMS). DPMS sends a binary code to the monitor via the horizontal and vertical sync signals. The monitor, in turn, decodes the message and shifts its circuits into the appropriate power-saving mode (see Table 3).

Step one is the full-power, normal mode where the monitor is active and receiving both horizontal and vertical sync signals. The next step is called standby, which is activated by disabling the horizontal sync while maintaining the vertical sync. At this level, the power is reduced by a mere 20%, which and is usually achieved by simply blanking the screen.

The third step is the suspend mode, in which the horizontal sync becomes active and the vertical sync shuts off. VESA specifies that the monitor consume no more than 30 watts at this level. While each vendor does it differently, the typical game plan is to turn off the high voltage (flyback circuit) and video drivers, while maintaining full power to the filaments. Recovery time to full screen brightness is typically 5 seconds or less.

The final stage is the off mode where both the horizontal and vertical sync are disabled. This tells the monitor to shut off all circuits—including the CRT's filament. The only thing kept alive is a watchdog circuit that looks for any sync activity which will awaken the display. Although DPMS dictates that the off-power consumption cannot exceed 8 watts, many DPMS-compliant monitors con-

Advanced Power Management: Power-Saving Protocol for Mobile PCs

Advanced Power Management (APM) is a layered approach to software power management that allows applications, operating systems, and the system BIOS to work together toward the goal of reducing power consumption. APM defines four power states: ready, standby, suspend, and off.

Ready. In the ready mode, the system or device is fully powered up and ready for use. No distinction is made between active and idle conditions.

Standby. Standby is an intermediate state that attempts to conserve power by using the chip set's timers to disable inactive devices. The difference between the BIOS default standby settings and APM is that APM-aware software can change the timer values as the application changes phases, resulting in more precise power management. The system can recover from standby mode by a device hardware interrupt (as happens when the device asks permission for microprocessor or memory access) or a CPU call to the device. All data and operational parameters are preserved when the system in the standby mode.

Suspend The suspend state is a special low-power condition that applies only to the system itself, and not its individual parts. The suspend mode is the lowest level of power consumption that guarantees to preserve operational data and parameters. The suspend state can be initiated by either the system BIOS or the application software. When the system is in the suspend mode, computation will not be performed until normal activity is resumed.

Off In the off state, the system or device is powered down and inactive. Data and operational parameters may or may not be preserved, depending on the BIOS.

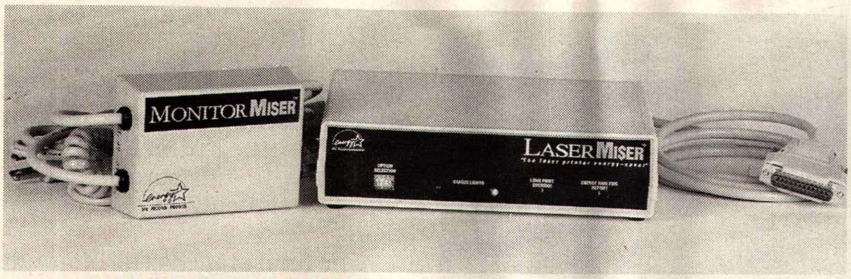


FIG. 5—MONITORMISER AND LASERMISER from EMPAC are companion energy savers that need no software to work. Both have DIP switches for setting their programming values. MonitorMiser uses a simple keyboard-sensing circuit to monitor PC activity. LaserMiser uses a microprocessor that analyzes and remembers your printing habits to power down a laser printer based on consumption.

sume less than 5 watts. In the off mode, recovery time is the same as it would be from a cold start, which can take up to 20 seconds and longer.

For display power management signaling to be effective, both the monitor and the video controller card must be DPMS-aware. The video controller must be able to interpret instructions from the DPMS software and process them to turn the sync signals on and off properly. While most of today's video controllers are DPMS compatible, there's a large base of existing video controllers, both on adapter cards and built into the motherboard, that aren't.

Fortunately, there are several TSR (terminate and stay resident) programs that allow video controllers built before the DPMS standard was accepted to signal a DPMS-compatible monitor properly (see Fig. 3). The programs work by accessing an unassigned video BIOS call that controls the horizontal sync and vertical sync signals.

Video-blanking signaling

Not all PCs are capable of DPMS signaling. Therefore, some monitors instead incorporate the video-blanking signaling method. The power-saving mode is triggered by a blank screen created by a screen saver, such as those in After Dark or Windows.

A blank screen is an all-black screen which has both the horizontal and vertical synch signals, but no red, green, or blue video information. By itself, a blank screen will reduce power consumption by 20% to 25% because the electron guns don't have to supply current to the screen.

When a video-blanking monitor detects a blanked screen and enters its power-saving modes, it takes control of the power-management process without help or instruction from the video controller. The power-down modes are controlled by an EEPROM built into the monitor. Typically, the power-down routine is similar to that established by VESA, but some monitors provide only the two-step power-down sequence suggested by Energy Star. The amount of time the monitor waits before acting on a blanked screen and the time intervals between the different power modes is usually user-programmable.

Printers

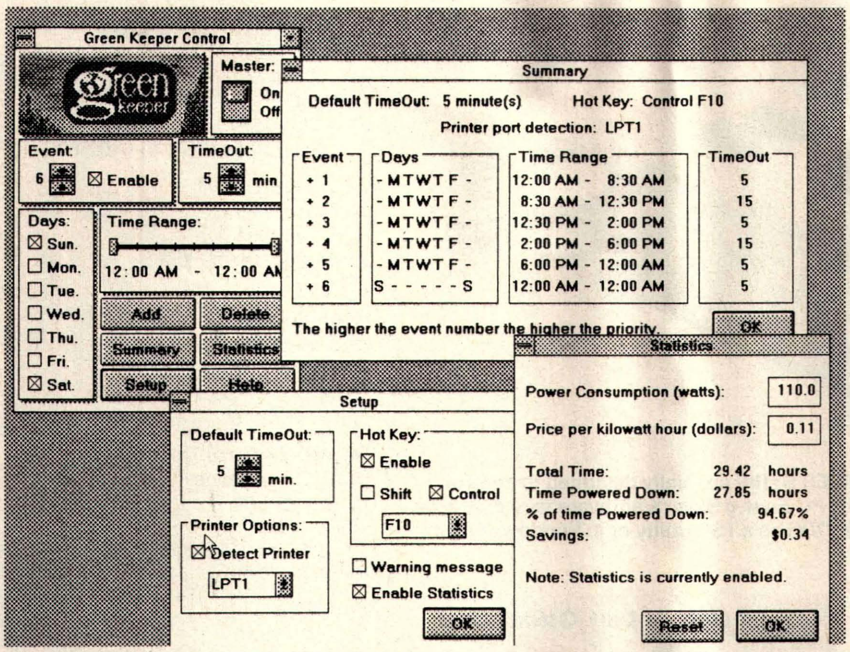
The laser printer has no peer as an energy hog. At full speed, a laser printer can easily consume 500 watts of power or more. Even in the idle state, some printers can waste 100 watts just keeping warm. That's why more and more printers feature a low-energy sleep mode that kicks in after a set period of inactivity. This mode trims the cost of running the printer. It also reduces wear and tear on the machine and cuts your office cooling costs.

Like systems and monitors, Energy Star printers must consume 30 watts or less when idle. And again like systems and monitors, not all Energy Star printers are created equal. The LaserJet 4L, for example, consumes five watts when asleep, yet it can responds instantly to a print request. Some other printer models consume 20 watts or more when asleep, and can take as long as 10 minutes to wake up and begin printing.

The HP LaserJet 4L is a good example of the type of laser printer that is common in home offices. It's light on price, about $599 on the street, and light on

TABLE A—RETROFIT HARDWARE

	Green Keeper	LaserMiser	Monitor Manager	MonitorMiser	PC Ener-g Saver	Wattless VDU Power Saver
Price	$69.95	$149.00	$25.00	$49.95	$79.95	$57.00
Manufacturer	B&B Electronics	EMPAC Int'l	Alpha Micro Technology	EMPAC Int'l	NEI	Ergonomics
AC operating voltage	90–130	90–140	110–240	100–240	90–130	100–250
Switch current, amperes	10	10	4	5	8	3
Surge current, amperes	20	20	10	10	10	90
Operating power, milliwatt	410	3000	100	500	320	n/a
Software programmable	Y	N	Y	N	Y	N
Hardware programmable	N	Y	Y	Y	N	Y
Warranty	3 yrs	3 yrs	90 days	3 yrs	5 yrs	2 yrs



Event: 6 ☒ Enable

TimeOut: 5 min

Days: ☒ Sun. ☐ Mon. ☐ Tue. ☐ Wed. ☐ Thu. ☐ Fri. ☒ Sat.

Time Range: 12:00 AM - 12:00 AM

Default TimeOut: 5 minute(s) Hot Key: Control F10

Printer port detection: LPT1

Event	Days	Time Range	TimeOut
+ 1	- M T W T F -	12:00 AM - 8:30 AM	5
+ 2	- M T W T F -	8:30 AM - 12:30 PM	15
+ 3	- M T W T F -	12:30 PM - 2:00 PM	5
+ 4	- M T W T F -	2:00 PM - 6:00 PM	15
+ 5	- M T W T F -	6:00 PM - 12:00 AM	5
+ 6	S - - - - - S	12:00 AM - 12:00 AM	5

The higher the event number the higher the priority.

Power Consumption (watts): 110.0

Price per kilowatt hour (dollars): 0.11

Total Time: 29.42 hours

Time Powered Down: 27.85 hours

% of time Powered Down: 94.67%

Savings: $0.34

Note: Statistics is currently enabled.

Default TimeOut: 5 min.

Hot Key: ☒ Enable ☐ Shift ☒ Control F10

Printer Options: ☒ Detect Printer LPT1

☐ Warning message

☒ Enable Statistics

FIG. 6—ALTHOUGH GREEN KEEPER HAS JUST ONE OUTLET, its 10-ampere load rating is enough to control a monitor, printer, and desk lamp simultaneously. Green Keeper has a dynamite software interface that lets you create up to nine different time-out events, and it generates a report of user activity and cost saved.

power consumption. In the print mode, it soaks up a fairly decent 120 watts of power—about as much as a large-screen monitor. But give it 15 minutes of rest, and it goes to sleep to the tune of just 5 watts. Power-up is described as "instantaneous," in that the fuser drum reaches its operating temperature well before most software can time out and display a print-error message.

A bigger, faster brother of the HP LaserJet 4 is the LaserJet 4 Plus, which has a throughput of 12 pages per minute (ppm). At full speed, it consumes a healthy 180 watts—twice the energy of a 15-inch monitor. Fortunately, it slows down to a cool 10 watts in the power-saving mode. The power-down interval is user-programmable in steps of 5, 15, 30, and 60 minutes. However, the LaserJet 4 Plus has a large transfer drum that can take up to 30 seconds to warm up to operating temperature. During this period, the 4-Plus's built-in 2-megabyte RAM buffers the data to emulate normal operation. Thus, the software application that is sending print data doesn't realize that the printer is just warming up and not ready to print.

Green retrofits: a buyer's guide

Yes, it's great news that new computer equipment is finally energy efficient. But what about the millions of existing devices—older PCs, monitors, and printers—out there that were made before Energy Star that continue to suck up power and greenbacks at an alarming rate? Fortunately, there is a good selection of add-on products that can turn your system into a lean, green machine. These power controllers generally are connected in the line between the AC outlet and the monitor or printer. They interrupt the flow of current (which is the same thing as flipping the on/off switch) when the device is idle. All perform as promised, shutting down equipment to save power, but each goes about it in different ways. Some are specifically designed for monitors, while others target printers; some do both. Here's a look at six such energy savers.

Wattless VDU Power Saver

Wattless is a small unit designed to power-down the video display by monitoring keyboard and/or mouse activity (see Fig. 4). It is supplied with cables that you hook to your PC, monitor, mouse, and keyboard. Thanks to a design that needs no software, the Wattless is the fastest and easiest of all power savers to install. A single slide switch located on the side of the case lets you choose a sleep time of 15, 30, or 60 minutes. If the Wattless doesn't detect any keyboard or mouse activity before the defined time expires, it shuts off power to its single AC outlet.

Unlike other power-saver controllers, which use a mechanical relay to switch the AC power on and off, the Wattless has a semiconductor relay built around a triac. The advantages are an inrush surge current of 90 amperes and zero-crossing switching that all but eliminates radio-frequency interference (RFI). However, the solid-state relay's continuous-current rating of three amperes is too low to handle a large-screen monitor and laser printer, too. A nice safety feature is a lamp on the side of the case that warns you if you have the polarity of the monitor's power cord reversed. The Wattless is priced at $57, but is less with substantial discounts for volume buyers.

MonitorMiser

Like the Wattless, MonitorMiser is a hardware-programmable monitor controller that's extremely easy to install. The MonitorMiser sits in-line between the keyboard, PC, monitor, and AC outlet, and requires no tools or software to install. Power-down times of 10, 18, 26, or 42 minutes can be switch-selected. Power is restored to the monitor within moments of touching any key on the keyboard. While the MonitorMiser doesn't connect directly to the mouse or mouse port, it can detect mouse activity for the PS/2 mouse that is supplied with most Compaq computer systems and many PC clones. However, it can't trigger off a serial mouse. The unit can supply five amperes of continuous current, enough for the largest monitor plus a desktop laser printer. It is fuse-protected and priced at $49.95.

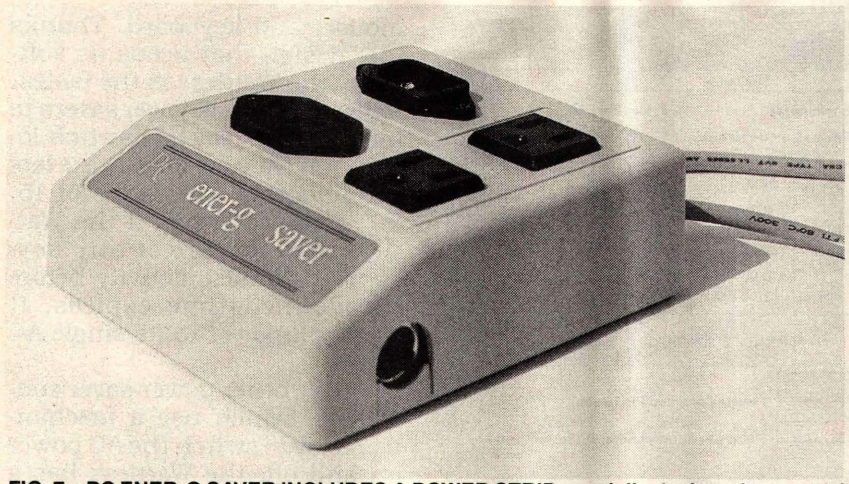


FIG. 7—PC ENER-G SAVER INCLUDES A POWER STRIP specially designed to control the monitor and a laser printer independently. PC Ener-g Saver's software take only a couple minutes to install, and operates under DOS as a TSR utility or in Windows as a startup application.

LaserMiser

The companion to the MonitorMiser is the LaserMiser. The LaserMiser is a microprocessor-based energy-saving controller that saves electrical power by automatically switching laser printers on and off. By monitoring and analyzing the data stream passed from the PC to the printer, the LaserMiser learns your consumption patterns and uses it to shut down the printer intelligently. For example, if you typically print intensively for 15 minutes and don't print for several hours afterward, LaserMiser will remember this pattern and shut down the printer immediately after hard-copy printing is complete. If you tend to do a lot of randomly-timed screen printouts, on the other hand, LaserMiser remembers this pattern too, and waits a few minutes before powering down the printer. When the printer is off or powering up, the LaserMiser buffers data in its built-in RAM.

The LaserMiser is installed between a parallel port and a compatible laser printer, including stand-alone printers and networked print servers. Serial connections to the PC are made through an external adapter. LaserMiser requires no special tools or software to install. All time-out settings and options are entered with four DIP switches located on the front panel (see Fig. 5). Although pricey at $149, LaserMiser is a master at curbing the high cost of keeping a laser printer on call 24 hours a day, 365 days a year.

Is It Light or Dark Green?

As with most green terminology, there's some confusion about what constitutes a light green and a dark green machine. Actually, the answer depends on which part of the green process you're talking about. Inside the PC, light green refers to systems that rely strictly on the keyboard or mouse to wake them. Dark green PCs can wake up on any I/O activity that generates a signal-management interrupt, as would be the case if the modem received an incoming message.

The other light/dark term refers to the environmentally-sound steps taken during the manufacturing process. Some manufacturers define light green PC's as those with built-in power management, and dark green systems as those that are manufactured without the use of toxic or ozone-depleting chemicals. Whichever shade of green you use is not as important as thinking green and putting it into practice.

MonitorManager

If it's lowest cost you're looking for, there's no beating Alpha Micro Technologies' $25 MonitorManager. Low cost doesn't mean low performance, here. Unlike many power savers, the MonitorManager works with or without a software driver—you decide. With the supplied software installed, the MonitorManager shuts down your monitor in two stages. If there is no keyboard activity within a defined time period of 1 to 9 minutes (5 minutes is default), MonitorManager first activates a screen saver. Three minutes after that, it shuts off power to the monitor. Without a software driver, MonitorManager shuts off AC power after 3 minutes.

WHERE TO BUY

After Dark
Berkeley Systems, Inc.
2095 Rose St.
Berkeley, CA 94709(510) 540-5535

Green Card
Micro Express
1801 Carnegie Ave.
Santa Ana, CA 92705
(800) 989-9900

Green Keeper
B&B Electronics
4000 Baker Rd.
Ottawa, IL 61350
(800) 346-3119

Hewlett-Packard Co.
DMO Organization
PO Box 58059
MS 511L-SJ
Santa Clara, CA 95051-8059
(800) 752-0900

LaserMiser
MonitorMiser
EMPAC Int'l Corp.
47560 Seabridge Dr.
Fremont, CA 94538
(510) 683-8800

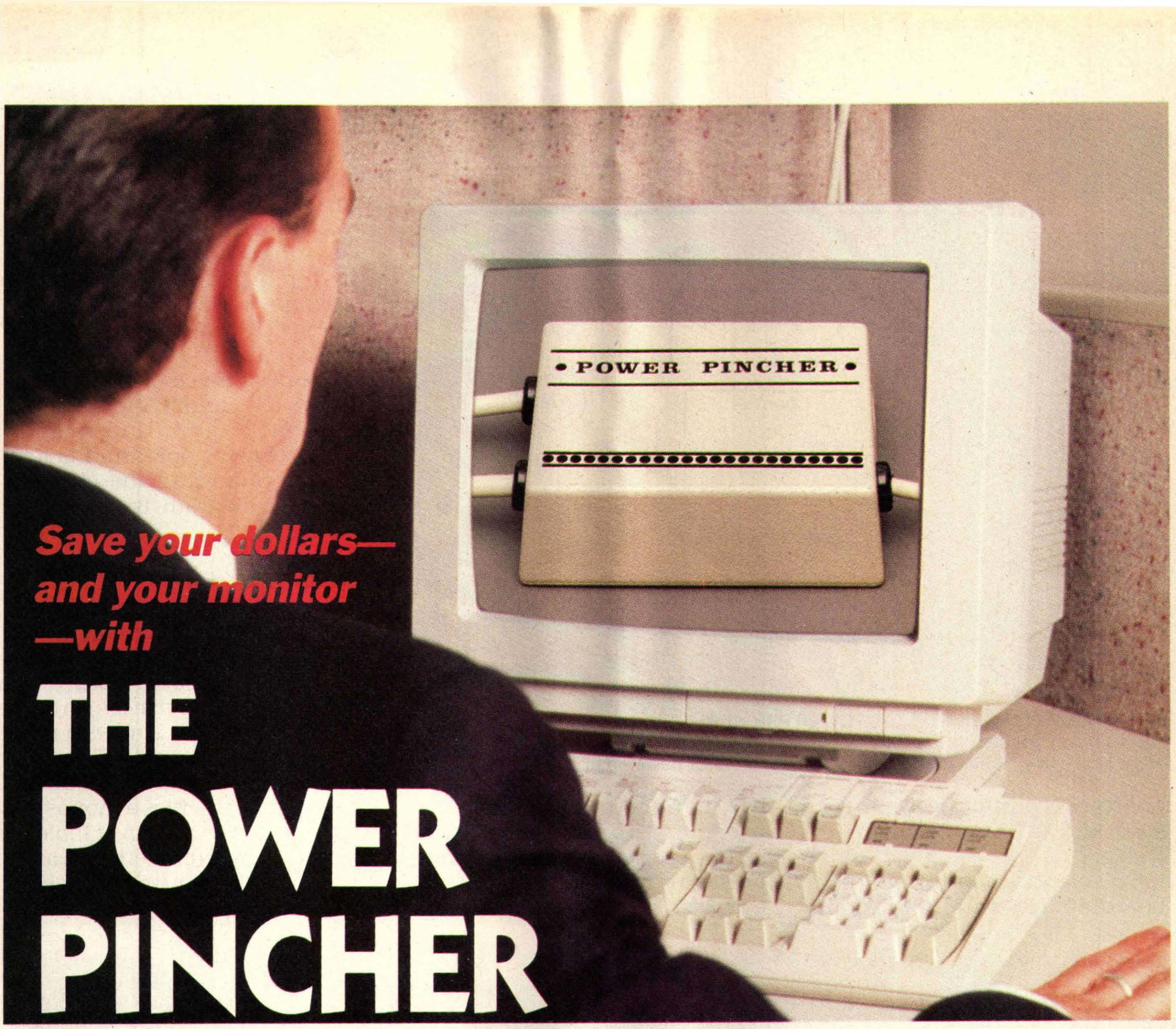
MonitorManager
Alpha Micro Technologies
275 Lirac Ct.
Alpharetta, GA 30202
(404) 772-0707

PC Ener-g Saver
NEI
23052 Alicia Pkwy. H455
Mission Viejo, CA 92692
(800) 832-4007

Wattless VDU Power Save
Ergonomics Inc.
PO Box 964
Southampton, PA 18966
(800) 862-0102

Should you opt not to use MonitorManager's software driver, the unit will only monitor for keyboard activity. With the driver installed, it will trigger on both the mouse and the keyboard. Current output to the single AC outlet is 4 amperes, enough to handle a monitor and inkjet or dot-matrix printer, but insufficient for controlling a large-screen monitor plus office-quality laser printer.

Continued on page 48



Save your dollars—
and your monitor
—with

THE POWER PINCHER

MICHAEL A. LASHANSKY

WHETHER ELECTRIC POWER IS GENerated by nuclear, hydroelectric, natural-gas, or coal-powered generators, one thing is for certain: it costs more today than it did yesterday. You can bet that it will cost more tomorrow than it does today.

If the thought of wasted electricity bothers you, you'll want to build the Power Pincher. It's a simple device that can monitor keyboard activity on an IBM-compatible personal computer. If no keys are pressed after a predetermined amount of time, the Power Pincher will cut off power to your monitor. Many new monitors and computer systems have this kind of power-down feature built right in. (See "Green PCs" on page 31 of this issue.) Power Pincher will give the same capability to an older system.

The complete Power Pincher circuit details, including foil patterns for the PC board, are presented here. In addition, a complete kit of parts is available at reasonable cost. (See the Parts List.) Power Pincher can actually pay for itself in less than a year, and it might prolong the life of your monitor, too.

How it works

Figure 1 is a block diagram of the circuit, in which a low-frequency oscillator continually drives the input of a multistage binary counter. Whenever the count reaches the setting selected by DIP switch S1, the circuit turns triac Q3 off, thereby interrupting the flow of 120-volt AC current to the monitor.

A keyboard-monitoring circuit keeps the video monitor powered up during active use by resetting the counter every time a key is pressed. As long as a key-press occurs before the time delay expires, the counter keeps resetting. Hence it never times out, and the monitor continues to receive power.

When the computer turns on, a routine in its basic input/output system (BIOS) polls the keyboard. The keyboard, in turn, sends a series of data pulses back to the microprocessor to indicate its status. The data line is normally high (+5 volts), and the pulses are low-going transitions. The first stage of the Power Pincher inverts the sense of the logic to normally low with high-going transitions.

Circuit description

The full Power Pincher circuit schematic is shown in Fig. 2. It consists of an input buffer (IC1-d), a peak detector (IC2 and Q1), a buffer stage (IC1-b and IC1-c), a programmable 24-stage bin-

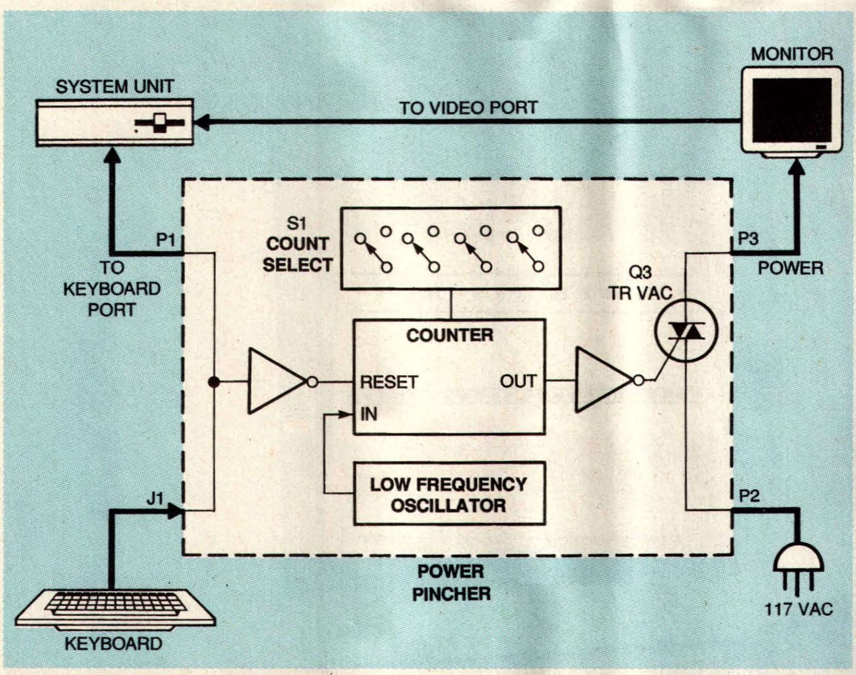

SYSTEM UNIT
TO VIDEO PORT
MONITOR
P1
TO KEYBOARD PORT
S1 COUNT SELECT
P3
POWER
Q3 TR VAC
COUNTER
RESET
OUT
IN
LOW FREQUENCY OSCILLATOR
J1
P2
POWER PINCHER
117 VAC
KEYBOARD

FIG. 1—BLOCK DIAGRAM OF THE POWER PINCHER: When the counter times out, the triac turns off and removes power from the monitor. The keyboard resets the counter every time a key is pressed, thus keeping the monitor powered up.

ary ripple counter (IC4), a triac (Q3), and an optoisolated driver (IC3).

The circuit monitors PC keyboard activity through five-pin DIN connector J1. When the user presses a key, the keyboard sends a series of negative-going pulses on pin 3. Capacitor C2 couples the signal to NAND gate IC1-d, which buffers it for use by op-amp IC2. In conjunction with Q1 and C3, the op-amp essentially functions as an integrator, which stretches the continually varying periods of the input pulses to a relatively constant period with a higher average DC value.

Inverters IC1-c and IC1-b buffer the peak detector's output to trigger IC4, an MC14536B programmable timer. Understanding the timer's operation is key to understanding the circuit; its block diagram is shown in Fig. 3.

The MC14536B

The MC14536B has two sets of dividers: an eight-stage block and a 16-stage block. The eight-stage block can be bypassed by setting pin 6 (8-BYPASS) high. The four binary inputs (A–D, pins 9 to 12) allow the user to specify which of the 16 counter stages then provides a monostable output via pin 13. (Table 1 shows the switch settings and corresponding output stages.) When the specified count oc-

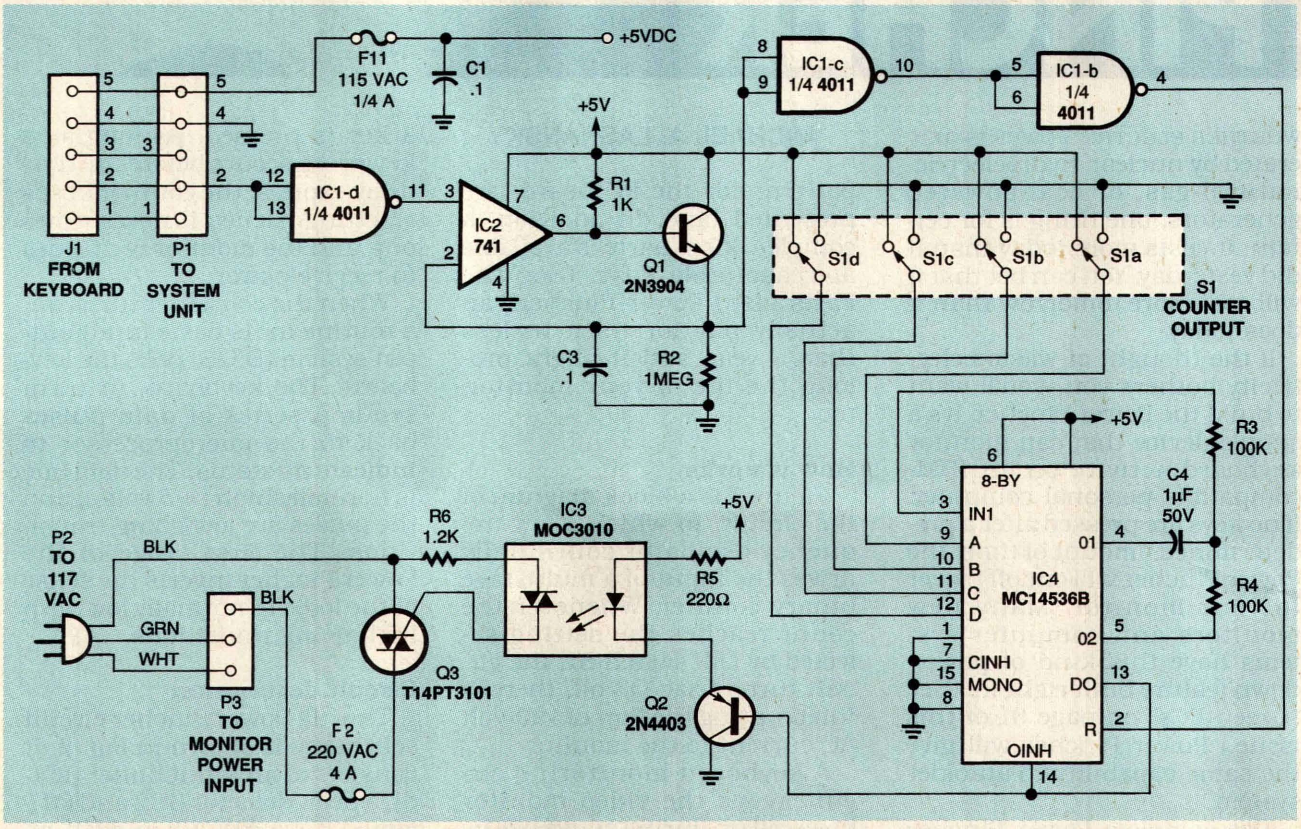

F11
115 VAC
1/4 A
C1
.1
+5VDC
8
9
IC1-c
1/4 4011
10
5
6
IC1-b
1/4
4011
4
+5V
R1
1K
5
4
3
2
1
12
13
IC1-d
1/4 4011
11
3
IC2
741
7
6
2
4
Q1
2N3904
S1d
S1c
S1b
S1a
S1
COUNTER
OUTPUT
J1
FROM
KEYBOARD
P1
TO
SYSTEM
UNIT
C3
.1
R2
1MEG
+5V
R3
100K
6
8-BY
3
IN1
9
A
10
B
11
C
12
D
1
7
CINH
15
MONO
8
IC4
MC14536B
01
4
C4
1µF
50V
R4
100K
02
5
DO
13
R
2
OINH
14
P2
TO
117
VAC
BLK
GRN
WHT
BLK
P3
TO
MONITOR
POWER
INPUT
R6
1.2K
IC3
MOC3010
+5V
R5
220Ω
Q3
T14PT3101
F 2
220 VAC
4 A
Q2
2N4403

FIG. 2—COMPLETE SCHEMATIC: The circuit is built around an MC14536B, a 24-stage programmable counter.

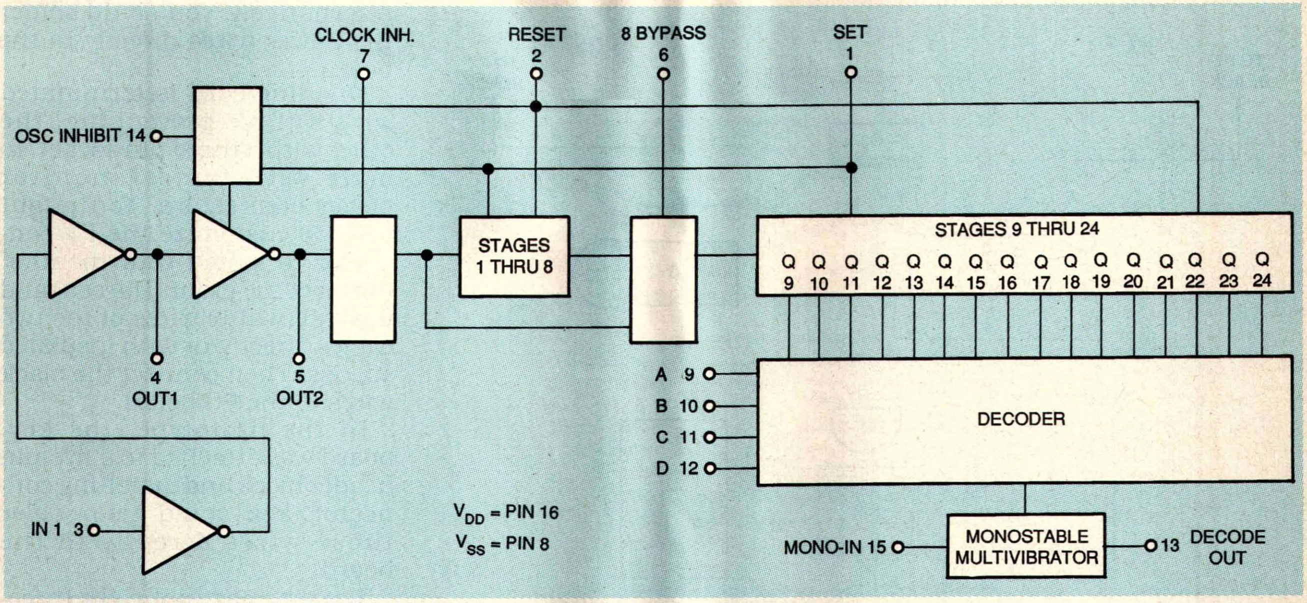


FIG. 3—BLOCK DIAGRAM OF THE MC14536B. Tie pin 6 high to bypass the first eight stages of the counter.

TABLE 1—MC14536B OUTPUTS AND SWITCH SETTINGS

DCBA	8-Bypass	Output	8-Bypass	Output
0000	1	1	0	9
0001	1	2	0	10
0010	1	3	0	11
0011	1	4	0	12
0100	1	5	0	13
0101	1	6	0	14
0110	1	7	0	15
0111	1	8	0	16
1000	1	9	0	17
1001	1	10	0	18
1010	1	11	0	19
1011	1	12*	0	20
1100	1	13*	0	21
1101	1	14*	0	22
1110	1	15*	0	23
1111	1	16	0	24

* = Recommended Settings

curs, pin 13 goes high, where it remains until the IC's RESET input (pin 2) goes from high to low, which in turn restarts the count cycle.

Input to the device can come from two sources: an external clock or an RC oscillator configured using the first few inverters in the MC14536B. The Power Pincher circuit uses the latter configuration. Returning to Fig. 2, the output frequency of the oscillator is given by the following equation:

$$f_O \approx 1 \div (2.3 \times R4 \times C4),$$

where f_O is in hertz, R4 is in ohms, and C4 is in farads. With the values specified, the circuit provides a base frequency of about 4.4 Hz. The 4.4-Hz signal can then be divided down as many as 24 times, theoretically giving delays as long as about 16 hours. Table 2 shows approximate delay times for the first 16 stages.

The time delays produced by the circuit depend on the accuracy of R3, R4, and C4. For that reason, all times given in this article are approximate. If an accurate delay time is important to you, you could tweak the value of one or more of the timing components while monitoring the circuit's output frequency at pin 5 of IC4.

On power-up, the monostable output (DECODE OUT, pin 13) goes high. The Power Pincher circuit ties that output to the INHIBIT input (pin 14), which puts the device in a low-current standby mode. The rising edge of the reset pulse then causes the output to go low, thereby disabling the inhibit function.

The monostable output of the MC14536B drives PNP transistor Q2. As long as pin 13 is low, Q2 conducts and, in turn, drives optoisolator IC4. That device contains a complete Triac driver. When the triac is on, AC current is available to power a monitor. On the other hand, when pin 13 goes high, Q3 goes off, so does the optoisolator, so does the triac, and so does the monitor.

In addition to monitoring the keyboard's data line, Power Pincher taps power and ground through the keyboard connector, hence no dedicated power supply is needed. A fuse (F1) in series with the +5-volt supply line provides protection for the host PC. Another fuse, F2, protects the monitor from line surges.

Construction

Construction of the Power Pincher is straightforward. No special construction procedures are required, but building the circuit on a PC board is recommended. Foil patterns are

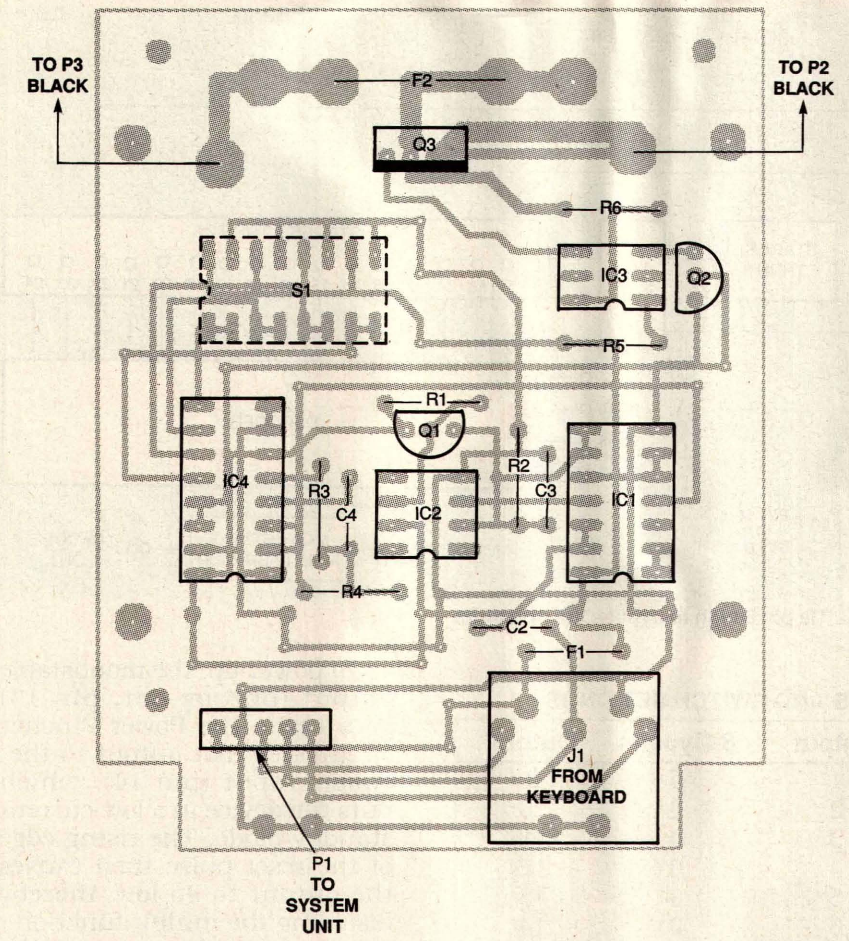


FIG. 4—MOUNT ALL COMPONENTS as shown here. Note that DIP switch S1 mounts on the foil side of the board.

shown here; you may also purchase a board from the source mentioned in the Parts List.

Start by mounting and soldering the lowest profile components first, gradually working your way up to the DIN connector J1 and the fuse holder for F2. The board provides two pad spacings to allow for standard fuse sizes. IC sockets are optional; unless you use premium-quality sockets, their installation is not recommended.

Make sure you mount Q3 in a vertical position; do not allow it to be bent over and accidentally apply 120 volts AC to the digital circuit! Unless you are pumping more than five amps through the triac, you won't need to use a heat sink. For the prototype, as shown in Fig. 4, board-mounted, noninsulated spade connectors were used to connect the black wires from the two power cables to the board. Alternatively, you could solder the power wires directly to the board.

One line cord is terminated with a three-prong plug, the other with a three-pin socket, to mate with typical monitor power connectors. You might have to customize the P3 connector to match your monitor. Connect the ground (green) and neutral (white) wires of the two cables directly, or with insulated spades. Then connect the black wires to the PC board.

In the prototype, the keyboard was attached to a five-pin header block and matching connector. You could also solder those wires directly to the board.

You may have noticed a three-pin jumper in the photo. The jumper in the prototype ensured compatibility with older XT-class PC's. Because of the rarity of that type of machine these days, the jumper was eliminated from the final design.

One final construction note: Be sure to mount the DIP switch on the foil side of the board so that it can protrude through the hole in the case supplied with the Power Pincher kit.

PARTS LIST

All resistors are ¼-Watt, 5%, unless otherwise noted.

R1—1000 ohms
R2—1 megohm
R3, R4—100,000 ohms
R5—220 ohms
R6—1200 ohms

Capacitors

C1, C3—0.1 uF, 50 volts
C2—100 pF, 50 volts
C4—1 uF, ceramic

Semiconductors

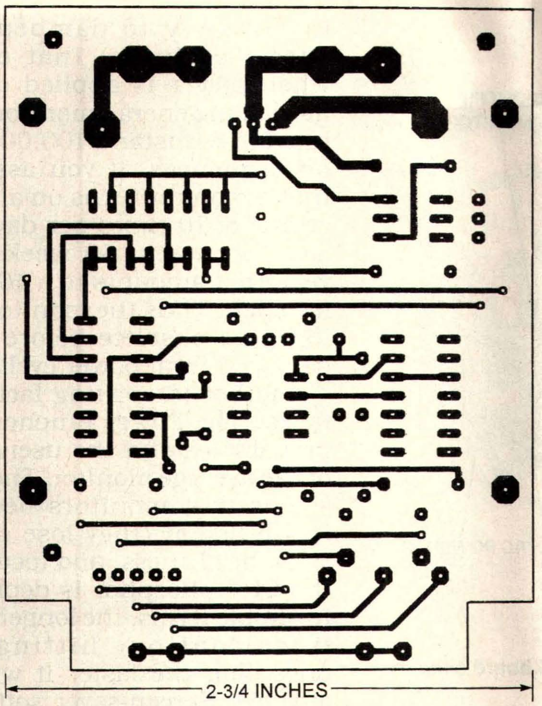
IC1—CB4011B quad NAND gate
IC2—741 op-amp
IC3—MOC3010 optoisolated triac driver, Motorola or equivalent
IC4—MC14536B 24-stage binary counter, Motorola or equivalent
Q1—2N3904 NPN
Q2—2N4403 PNP
Q3—T14PT3101 triac, Texas Instruments or equivalent

Other components

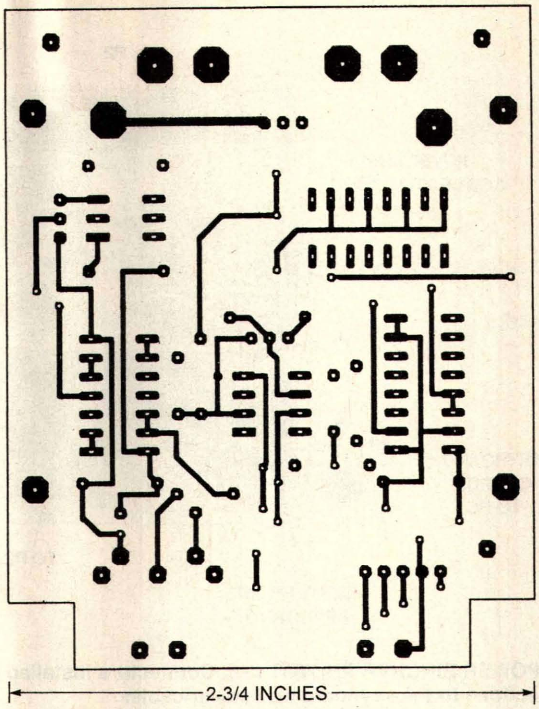
S1—4-pole SPDT DIP switch
F1—115 VAC, 250 mA, (Pico Fuse 251.250 or equiv.)
F2—4A slow blow fuse
J1—5-pin DIN jack for IBM compatible keyboard
P1—IBM keyboard cable with 5-pin DIN connector on one end
P2—AC line cord with male end
P3—AC line cord with female end (or as required to match your monitor)
Other—Fuse holder (2), 5-pin header with 0.1″ spacing and mating connector, insulated male Panduit spade (2), insulated female Panduit spade (2), noninsulated male Panduit spade (2), strain reliefs (3), case (Unibox 01 or equiv.), pc board, mini DIN adapter, wire, solder, etc.

ORDERING INFORMATION

The following items are available from Eikim Electronics, 4142 Old Almonte Road, RR#4, Almonte, Ontario, Canada, K0A 1A0. (613) 256-0224. Kit of all parts listed above ($45). Check or money order. Commercial orders welcome; quantity discounts available for assembled and tested units.



POWER PINCHER COMPONENT SIDE FOIL PATTERN.



SOLDER SIDE FOIL PATTERN.

Why bother?

Consumers, the government, and industry, are all being forced to take a long, hard look at energy consumption patterns. Take your average computer monitor for example. If left running continuously for 24 hours a day, seven days a week, the yearly cost to run that monitor would be about $145.

The chances are, however, that the monitor is used only sporadically throughout that period. If you assume that the monitor consumed energy only when it is really needed—about 15 hours per week—the cost would be reduced to only about $15 yearly. On an individual basis, that's quite a cost reduction. When you scale those numbers to cover corporate and government use, savings mount up even more dramatically. For example, 100 continuously running monitors translates into $13,000 of wasted power, and 1000 monitors wastes $130,000 worth of electricity. Furthermore, those calculations include only direct operating costs, and ignore additional costs of air conditioning required to offset heat generated by the monitors. The U.S. Government considers wasted power to be of such concern that it has legislated that all computer monitors sold in the U.S. after 1998 must have an automatic shutdown feature. The Power Pincher can retrofit any PC clone computer to achieve those goals.

An additional benefit is that use of the Power Pincher can actually extend monitor life by decreasing the usage rate of CRT phosphors.

TABLE 2—DELAYS PRODUCED BY STAGE

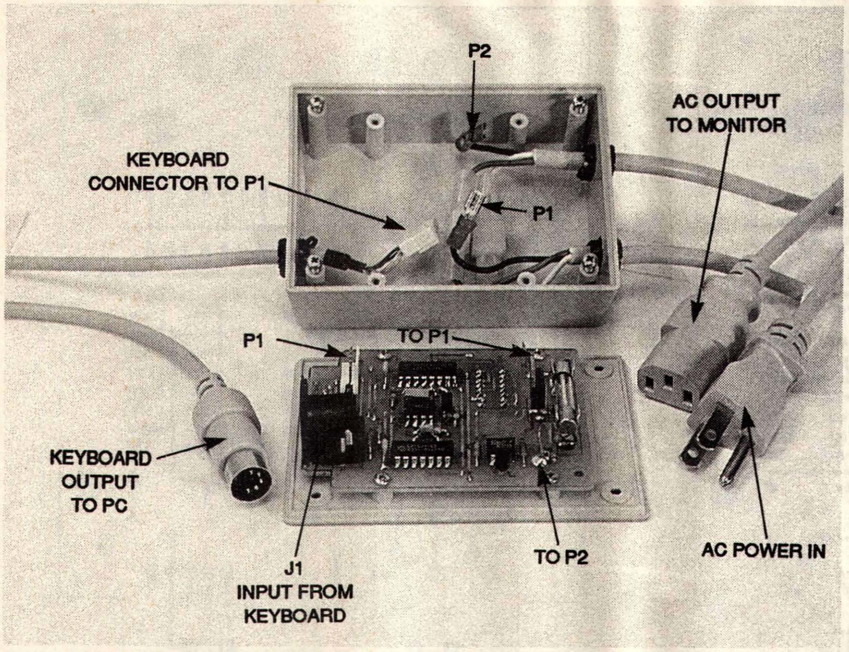
Stage	Hz	Seconds	Minutes	Hours
1	4.4	0	0	0
2	2.2	0	0	0
3	1.1	0	0	0
4	0.55	1	0	0
5	0.275	3	0	0
6	0.1375	7	0	0
7	0.06875	14	0	0
8	0.034375	29	0	0
9	0.017187	58	1	0
10	0.008593	116	2	0
11	0.004296	232	4	0
12	0.002148	465	8	0
13	0.001074	930	16	0
14	0.000537	1861	32	0
15	0.000268	3723	64	1
16	0.000134	7447	128	2

Checkout and calibration

After building the circuit, make sure that every component is mounted in the right place and with the correct orientation. Also check that all of your solder joints are perfect before you try to verify the Power Pincher's operation. Before you plug in the line cord, put the circuit into an insulated case. Because the circuit has 120 volts AC present at various points, it is easy to destroy the Power Pincher, your computer, or injure yourself if you are not careful.

Turn your computer off and plug its keyboard into J1. Then insert P1 into the keyboard port on your PC. (The kit of parts includes an adapter for the mini-DIN PS/2 style plug; use it if necessary). Next, unplug the monitor's line cord, plug the Power Pincher's female end into the back of the monitor, and the male end into the wall outlet. Leave your monitor switch in the on position.

Using Table 2 as a guide, set S1 for a short delay, say, 8 or 16 seconds. Then turn on the computer. The monitor should come



THE POWER PINCHER PROTOTYPE. Connectors installed on the PC board simplify connections to the keyboard and power cables.

on shortly after your keyboard is polled, and turn off shortly thereafter. Press a key; the monitor should come back on and begin a new delay. Repeat the process several times to verify that the Power Pincher is operating properly. Then set S1 for the desired delay. The author found the eight-minute setting most suitable.

Further notes

One concern that many people have about this kind of circuit is the the effect of increased power cycling on a monitor's working life. Hence we contacted several major monitor manufacturers to get their recommendations.

The consensus is that all UL/CSA listed monitors have built-in circuitry to dampen the effects of surges that occur when power is applied or removed. In general, monitors are rated to withstand 100,000 on/off sequences. If you assume that a monitor turns on and off a total of 10 times per day, five days per week, 50 weeks per year, that amounts to a 40-year life span. Thus the monitor will likely be obsolete before it is damaged from power cycling.

Another interesting fact surfaced: The Power Pincher will probably *extend* the useful life of the average monitor. The reason is that monitors become less efficient (they lose crispness, brightness, and focus) as the CRT phosphor is depleted. In simple terms, the longer electrons continue hitting the phosphor, the faster it will be affected. Screen-saver software can protect against image burn-in, but it does nothing to stop wear and tear on the phosphor. Thus, the only way to extend CRT lifespan is to remove power. In fact, a study done for the Canadian government revealed that useful monitor life could be increased from three to at least five years through the use of automatic power-down devices. Ω

GREEN PC'S

continued from page 42

Green Keeper

The most ambitious stand-alone power controller is Green Keeper from B&B Electronics. Green Keeper is completely software driven (there are no hardware defaults), which adds extra steps and time to the installation process. The software communicates with the Green Keeper unit via the keyboard cable to turn off the monitor after a user specified time. The software lets you create up to nine different shutdown scenarios. For example, you can program it to shut down after 15 minutes of inactivity between 8 AM and 12 noon. During your lunch break, a second event timer would kick in to turn your monitor off after just one minute of inactivity. After that, a third timer would reset the time-out value back to 15 minutes for the rest of your workday. You can also set different time outs on different days (see Fig. 6).

In addition to monitoring the keyboard and mouse for activity, Green Keeper keeps an eye on your printer's activities. This prevents it from shutting down during times when the printer is active and the keyboard and mouse aren't. Green Keeper's 10-ampere load rating is robust enough to control a monitor, laser printer, and a desk lamp when used with a power strip. Its price is $69.95, with price breaks on quantity purchases.

PC Ener-g Saver

Like the Green Keeper, NEI's PC Ener-g Saver is a software-driven stand-alone power controller that monitors keyboard, mouse, and printer activity. However, PC Ener-g Saver takes power control one step further by providing separately switched outlets for the monitor and printer. The outlets are controlled by independent timers; this means that the printer can be shut off while the monitor is powered up, and visa versa. Users can select printer ports and printer warm-up time, and schedule the monitor and printer to turn off at the end of the day. PC Ener-g Saver also features a management report that audits energy use and costs. Total switching current is eight amperes, and the unit is fuse-protected. It's moderately priced at $79.95. Like the other products mentioned here, PC Ener-g Saver will save you money in the long run. Ω

Add text overlays to your home video with this handy device.

BUILD THIS VIDEO TITLER

DAN MICHELSON

TEXT OVERLAYS CAN MAKE ANY VIDeo recording more valuable and informative. Now you can build a video titler to create your own text overlays or titles and add them to your home recordings. The video titler is a small, handheld device that can overlay black or white text on any composite video source. The overlay area consists of 12 rows of 24 characters per row or 6 rows of 12 characters per row of double-size characters. A maximum of 110 normal-size characters, including line feeds, can appear on the display at any one time, and a maximum of 72 double-size characters can appear.

To input text, any one of three interfaces can be used, all connected through a female DB9 connector. First, an IBM PC/AT type keyboard can be attached, allowing a user to type in overlays. Second, commands can be input from an interactive RS-232 interface. Last, an RS-485 network-type interface is provided. The RS-485 interface conforms to the HCSII protocol used in the Circuit Cellar Home Control System Network.

Overlay text is stored and recalled from a 1024-bit EEPROM with non-volatile data storage. Character intensity and outline can be individually adjusted via software-controlled potentiometers (EEPOTs). The device is small in size, measuring only about 3¾ inches long, 2⅜ inches wide, and 1 inch high.

The 87C055

The 87C055 microcontroller for television and video from Philips Semiconductor is the heart of the Video Titler. It is a derivative of the industry-standard 80C51 microcontroller. The 87C055's features include:

- 16K × 8 one-time-programmable (OTP) EPROM
- 256 × 8 RAM
- On-screen display (OSD) controller IC
- 128 × 10 display RAM
- 60 × 18 × 14 character generator OTP EPROM
- Eight 6-bit pulse width modulators ICs
- One 14-bit pulse width modulator IC
- Two 16-bit timer/counters
- D/A converter/comparator with 3-input multiplexer
- Four high-current open-drain outputs
- Twelve high-voltage (+12V) open-drain outputs

Many of those resources are not used in the video titler circuit, but they could be useful to readers who can write their own software.

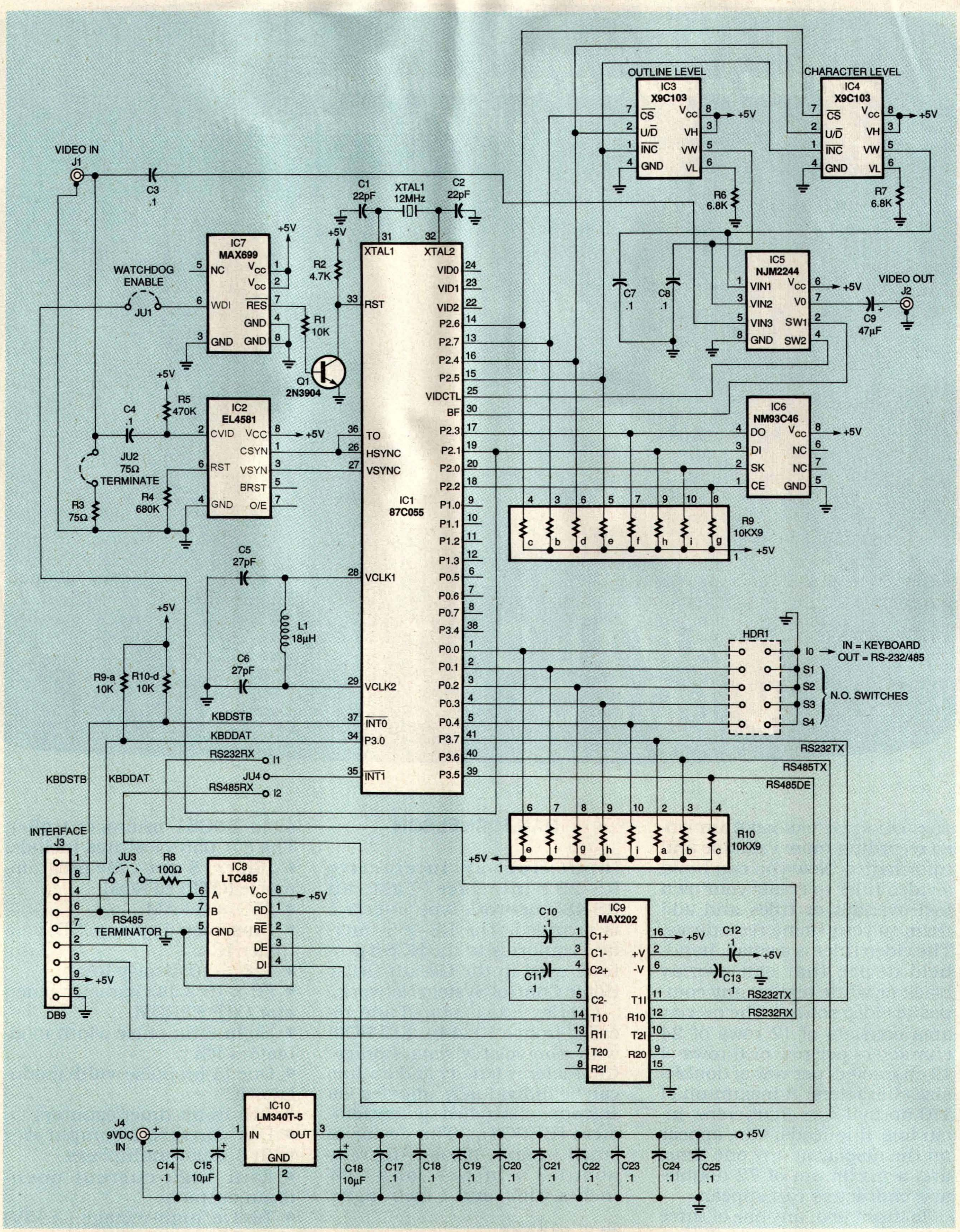

VIDEO IN
J1
C3
.1
WATCHDOG
ENABLE
JU1
IC7
MAX699
NC
VCC
WDI
RES
GND
R1
10K
R2
4.7K
Q1
2N3904
C1
22pF
XTAL1
12MHz
C2
22pF
XTAL2
RST
IC1
87C055
VID0
VID1
VID2
P2.6
P2.7
P2.4
P2.5
VIDCTL
BF
P2.3
P2.1
P2.0
P2.2
P1.0
P1.1
P1.2
P1.3
P0.5
P0.6
P0.7
P3.4
P0.0
P0.1
P0.2
P0.3
P0.4
P3.7
P3.6
P3.5
TO
HSYNC
VSYNC
VCLK1
VCLK2
INT0
P3.0
INT1
+5V
R5
470K
C4
.1
IC2
EL4581
CVID
CSYN
VSYN
BRST
O/E
JU2
75Ω
TERMINATE
R4
680K
R3
75Ω
C5
27pF
L1
18μH
C6
27pF
R9-a
10K
R10-d
10K
KBDSTB
KBDDAT
RS232RX
I1
JU4
RS485RX
I2
OUTLINE LEVEL
IC3
X9C103
CS
U/D
INC
VH
VW
VL
R6
6.8K
CHARACTER LEVEL
IC4
X9C103
R7
6.8K
C7
.1
C8
.1
IC5
NJM2244
VIN1
VIN2
VIN3
V0
SW1
SW2
VIDEO OUT
J2
C9
47μF
IC6
NM93C46
DO
DI
SK
CE
R9
10KX9
HDR1
I0
S1
S2
S3
S4
IN = KEYBOARD
OUT = RS-232/485
N.O. SWITCHES
RS232TX
RS485TX
RS485DE
R10
10KX9
INTERFACE
J3
DB9
JU3
R8
100Ω
RS485
TERMINATOR
IC8
LTC485
A
B
RD
RE
DE
DI
IC9
MAX202
C10
.1
C11
.1
C12
.1
C13
.1
C1+
C1-
C2+
C2-
T1O
R1I
T2O
R2I
T1I
R1O
T2I
R2O
+V
-V
RS232TX
RS232RX
J4
9VDC
IN
IC10
LM340T-5
IN
OUT
GND
C14
.1
C15
10μF
C16
10μF
C17
.1
C18
.1
C19
.1
C20
.1
C21
.1
C22
.1
C23
.1
C24
.1
C25
.1

FIG. 1—SCHEMATIC OF THE VIDEO TITLER CIRCUIT. The power-on reset function is generated by IC7, a MAX699. That device supplies a reset pulse of 140–500 milliseconds at power-up.

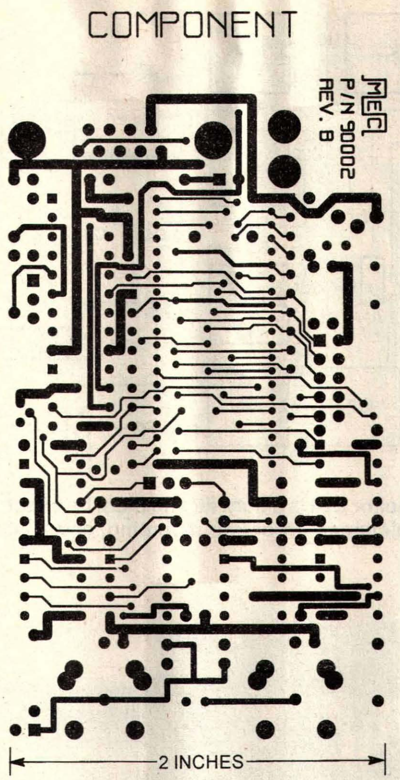
Circuit description

Figure 1 shows the schematic of the video titler circuit. The power-on reset function is generated by IC7, a Maxim MAX699 reset and watchdog pulse generator. That device supplies a reset pulse of 140–500 milliseconds at power-up. The watchdog function is enabled by tying the WDI input at pin 6 to a logic high or low; if the pin is left floating, the function is disabled. Therefore, if jumper JU1 is inserted, the watchdog function is enabled. This pin must be toggled a minimum of once a second, or the watchdog will time out and generate a reset to the processor. The reset from IC7 is inverted by transistor Q1 because microprocessor IC1 requires an active-high reset.

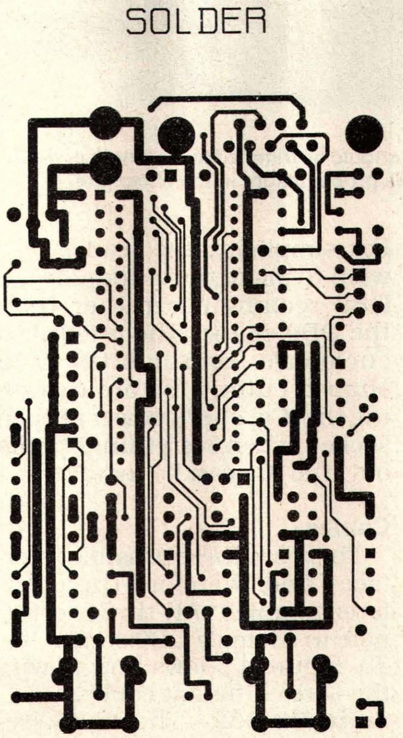
The overlay text must be synchronized, or *genlocked* to the input video. Genlocking is simply the synchronization of two video sources by locking horizontal and vertical timing together. This is accomplished with some external parts as well as the OSD controller in IC1. First, the horizontal and vertical sync from the composite video input is detected by IC2, which is set for NTSC specification horizontal and vertical synchronization timing via resistor R4.

The detected horizontal and vertical sync is fed to IC1. The OSD controller in IC1 uses these signals to internally synchronize the overlay text to the incoming video. The frequency of the dot clock is controlled by components L1, C5, and C6. Text is overlaid by video multiplexer IC5 which is controlled by IC1. This device has onboard input clamps and a 75-ohm output driver. The video input can be terminated to 75 ohms by shorting jumper JU2.

The overlay character outline and intensity are controlled via solid-state potentiometers IC3 and IC4 respectively. The solid-state potentiometers allow the microcontroller to control the position of their wipers and store the settings in an onboard EEPROM. This provides a self-contained, non-volatile, software-controlled potentiometer. The microcontroller's OSD logic controls the multiplexer timing from the BF (IC1, pin 30) and VIDCTL (IC1 pin 25) signals. The BF signal switches the video multiplexer between character and character-outline video, and VIDCTL switches the multiplexer between the input video and the overlay video from IC1. The DC levels from IC3 and IC4 set the character and outline intensity, and these levels are fed to video multiplexer IC5. The output of IC5's internal multiplexer is fed to an internal 75-ohm output driver and then output at pin 7.



COMPONENT SIDE OF THE VIDEO titler board.



SOLDER SIDE OF THE VIDEO titler board.

The video titler can store and recall text from EEPROM IC6, which has enough capacity to store one overlay screen and other required data such as network address, horizontal and vertical overlay fine position, and type of interface.

The RS-232 interface is provided by a MAX202 transceiver which contains two line drivers and two receivers. The device also contains a charge pump that allows it to generate +10-volt and −10-volt sources for the RS-232 interface from a single +5-volt supply. The RS-485 interface is provided by an LTC485 transceiver that provides both transmit and receive functions. The keyboard interface is basically a direct connection to the microprocessor. All three interfaces are attached through DB9 connector J3.

Construction

For best results, this project should be assembled on a printed circuit board. The microprocessor has pins on 0.070-inch centers. That makes the use of standard perforated construction board with 0.1-inch centers very difficult. You can make your own PC board from the foil patterns provided here, or you can buy one from the source given in the Parts List. A programmed microprocessor (IC1) is also available.

The binary code for IC1 is available as part of a ZIP file called VIDTITE.ZIP on the Gernsback BBS (516-293-2283, v.32, v.42bis) for those with access to a programmer. Because this is a one-time programmable (OTP) device, you get only one shot at programming it. Unless you have an emulator for the processor to debug your own code, the code from the BBS should be used. The code provides a flexible user interface.

The parts placement diagram is shown in Fig. 2. Insert all resistors, capacitors, and induc-

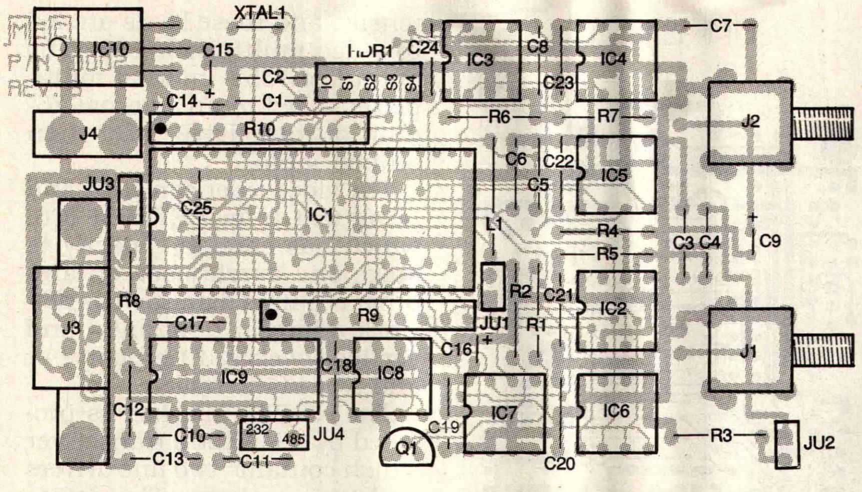


FIG. 2—PARTS PLACEMENT DIAGRAM. Capacitor C24 is a tight fit, and must be offset slightly. One of the pins on jack J4 must be clipped off before mounting, and IC10 should be mounted flat against the board.

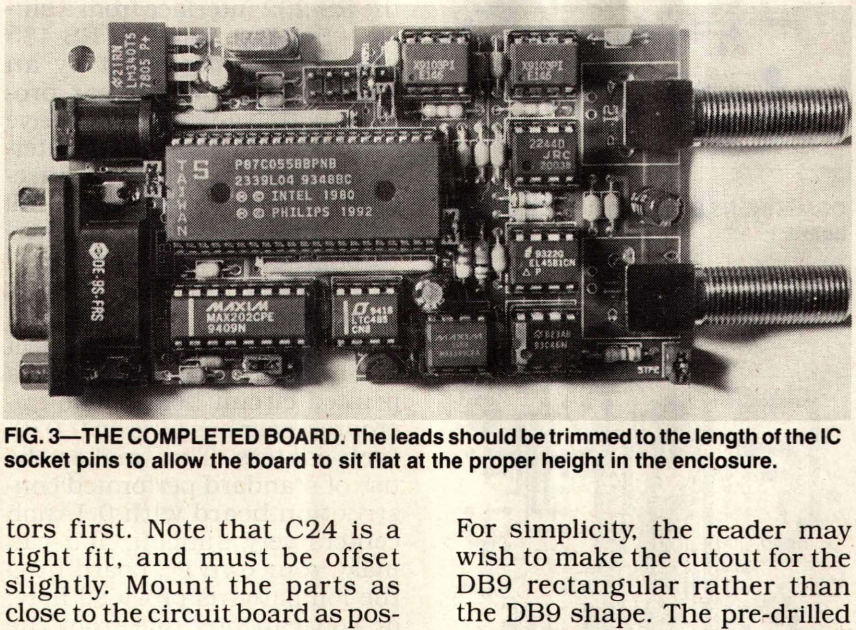


FIG. 3—THE COMPLETED BOARD. The leads should be trimmed to the length of the IC socket pins to allow the board to sit flat at the proper height in the enclosure.

tors first. Note that C24 is a tight fit, and must be offset slightly. Mount the parts as close to the circuit board as possible. Next, mount all of the IC sockets. Finish by mounting the rest of the parts. Note that one of the pins on jack J4 must be clipped off before mounting. Voltage regulator IC10 should be mounted flat against the board with its leads bent at 90 degrees. Figure 3 shows the completed board.

When all components have been soldered in place, the leads should be trimmed to the length of the IC socket pins to allow the board to sit flat at the proper height in the enclosure. If a stock enclosure is purchased instead of the pre-drilled one available with the kit, it must be modified before the input and output jacks can be installed. For simplicity, the reader may wish to make the cutout for the DB9 rectangular rather than the DB9 shape. The pre-drilled enclosure from has the DB9 shaped cutout. Before installing the ICs, check power at each socket. When everything checks out, the ICs can be installed.

Cables

There are three possible interfaces and therefore three different cables. All three terminate in a female DB9 connector, J3. Figure 4 shows how to wire the three different cables.

Serial RS-232—The RS-232 serial cable is simply a one-to-one male-female DB9 cable that ties pins 2, 3, and 5 together. Only pins 2, 3, and 5 must be connected. Any RS-232 signals driven into other pins can cause damage. (See Fig. 4-*a*.)

PC/AT keyboard—Rather than make this cable from scratch, a readily available PC/AT keyboard extension cable be purchased and modified. Just about any computer supply store stocks these cables. By cutting off the male end (the one that does not mate with the keyboard) and installing a DB9 male connector, this cable can be assembled quickly. After cutting off the connector, the wires will have to be tested for con-

PARTS LIST

All resistors are ¼-watt, 5%
R1—10,000 ohms
R2—4700 ohms
R3—75 ohms
R4—680,000 ohms
R5—470,000 ohms
R6, R7—6800 ohms
R8—100 ohms
R9, R10—10,000 ohms, SIP

Capacitors
C1, C2—22 pF, ceramic
C5, C6—27 pF ceramic
C3, C4, C7, C8, C10–C14, C17–C25—0.1 µF, ceramic
C9—47 µF, 16 volts, electrolytic
C15, C16—10 µF, 35 volts, radial electrolytic

Semiconductors
IC1—P87C055BBPNB microcontroller (Philips—unprogrammed part available from Marshall or Hamilton Hallmark)
IC2—EL4581CN video sync separator (Elantec—available from Marshall)
IC3, IC4—X9C103P, 10K EEPOT (Xicor—available from Marshall or Hamilton-Hallmark)
IC5—NJM2244D video multiplexer (NJRC—available from MEC)
IC6—NM93C46N 1024-bit EEPROM (National—available from Digi-Key)
IC7—MAX699CPA watchdog (Maxim—available from Digi-Key)
IC8—LTC485CN8 RS485 transceiver (LTC—available from Digi-Key)
IC9—MAX202CPE RS-232 transceiver (Maxim—available from Digi-Key)
IC10—LM340T-5 voltage regulator, 5 volts, 1.5-amp
Q1—2N3904 NPN transistor

Other components
L1—22 µH inductor, 5%
J1, J2—right-angle female F connector

J3—DB9 right angle female J4—2 mm right angle power jack
XTAL1—12 MHz crystal
T1—9-volt DC, 200 mA adapter
JU1–JU3—2 pin, 0.1-inch header
JU4—3 pin, 0.1-inch header
HDR1—10-pin, 5-position, 0.1-inch header

Miscellaneous: Seven 8-pin DIP sockets, one 16-pin DIP socket, one 42-pin shrink DIP socket for IC1, six shorting jumpers for I0–I2 and STP1–STP3, Enclosure (Pactec Model HM drilled for fit), PC board, two male "F" connector to RCA female phono jack adapter, RCA video cables.

Note: The following items are available from MEC, 1036 Marshall Drive, Des Plaines, IL 60016:

- **Printed Circuit Board and full assembly documentation (VTKIT 1)—$25.00**
- **Programmed 87C055 Microprocessor, Printed Circuit Board, and full assembly documentation (VTKIT 2)—$65.00**
- **Partial kit (contains PC board, programmed microprocessor, all parts that mount on the PC board, and full assembly documentation (VTKIT 3)—$159.00**
- **Complete kit (contains PC board, programmed microprocessor, all parts that mount on the PC board, pre-drilled enclosure, wall transformer, and full assembly documentation (VTKIT 4)—$179.00**

Check or Money orders only. Illinois residents add 8.25% sales tax. Add $4.00 to all orders for shipping and handling.

tinuity to determine which pin goes to which wire. (See Fig. 4-*b*.)

RS-485—RS-485 generally involves connecting network wires to a terminal block. Since the board space did not make this practical, the RS-485 connections were assigned two pins on the female DB9 connector J3. The reader can connect these in any manner that makes sense in the chosen network environment. (See Fig. 4-*c*.) Details on RS-485 operation are contained in the ZIP file available on the Gernsback BBS (516-293-2283, v.32, v.42bis).

The first power-up

On first power-up, the software will initialize the EEPROM (IC6) checksum, set the EEPOTs (IC3 and IC4) to default intensities, and overlay the video titler character set on the display. Connect a noise-free composite video source such as that from a video camera to the video input connector J1. Next, connect video output J2 to a composite video monitor or the video input of a VCR whose output is connected to a TV. Install jumpers for JU1–JU4 and HDR1 as needed for the type of interface you are using (see Fig. 5). For the first power-up, a serial RS-232 or keyboard interface should be used.

The cable for the chosen interface should be attached to J3 and connected to the keyboard or RS-232 serial device (a "dumb" terminal or PC running a terminal-emulation program) Plug the wall-mount adapter into an outlet and insert its DC

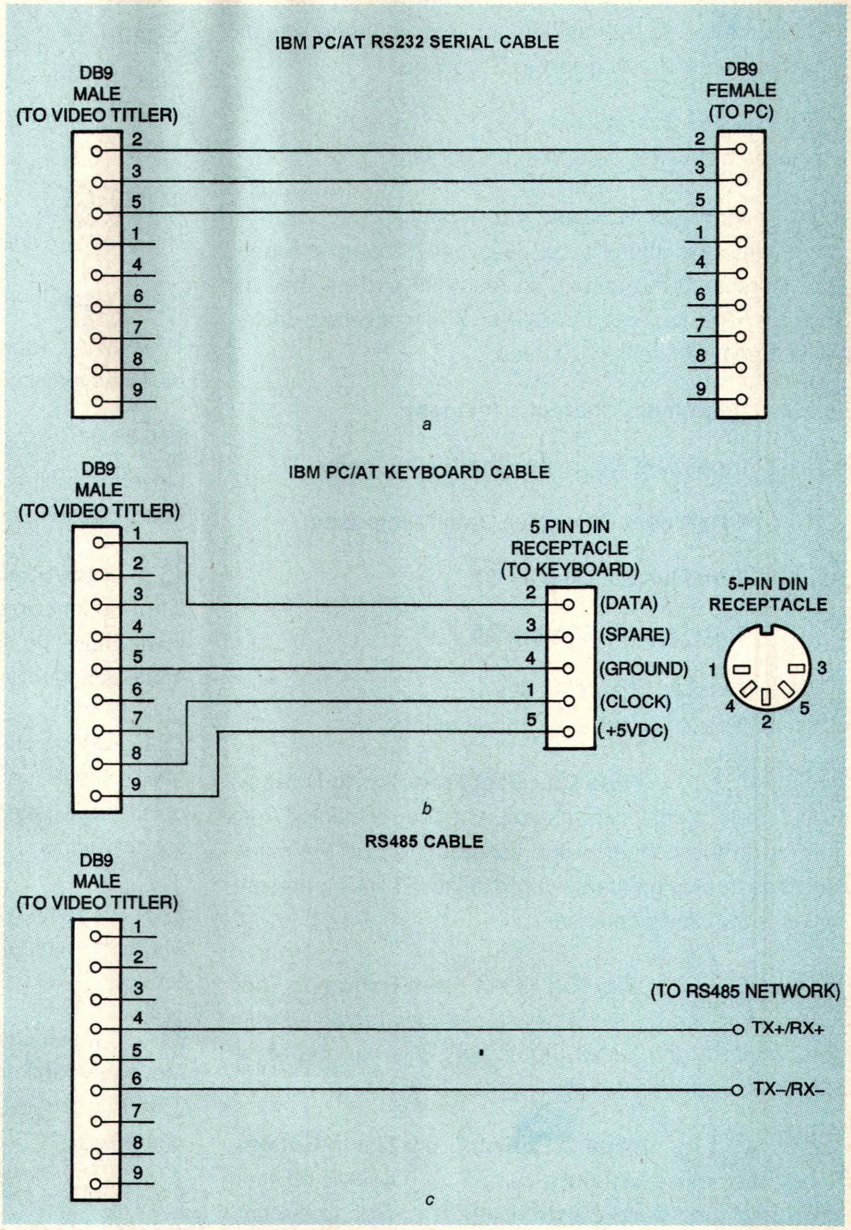


FIG. 4—THERE IS A DIFFERENT CABLE for each interface. The RS-232 serial cable is shown in *a*, the PC/AT keyboard cable is shown in *b*, and the RS-485 cable is shown in *c*.

TABLE 1—CONTROL-KEY FUNCTIONS

F1 **Enter Edit Mode**

Automatically clears the screen and places the cursor at line 1, column 1. Once in the Edit mode, overlay text can be entered.

F2 **Exit Edit Mode With No Overlay Save**

Exits the Edit mode and no further editing of characters on the screen can occur. No Overlay data is saved.

F3 **Exit Edit Mode and Save Overlay**

Exits the Edit mode and saves the current overlay data. This includes the fine horizontal and vertical position.

F4 **Recall Overlay**

Recalls the stored overlay data and puts it on the screen. This function is not available in Edit mode.

F5 **Clear Overlay**

Removes all overlay data from the screen.

F6 **Increment Character Intensity**

Increments the intensity of the overlay character video. The increments are small, so many keystrokes may be required. The key can be held down for a repeat increment. Each new setting is stored.

F7 **Decrement Character Intensity**

F8 **Increment Character Outline Intensity**

F9 **Decrement Character Outline Intensity**

F10 **Turn Overlay Display Off**

F11 **Turn Overlay Display On**

F12 **Display Character Set**

This function is not available in Edit mode.

SHIFT + F1 **Wipe On Effect From Top to Bottom**

The current overlay is turned off, and then repainted from the top to the bottom of the screen. This has the same effect as turning on the overlay display (F11). The presentation is the only difference.

SHIFT + F2 **Wipe On Effect From Bottom to Top**

The current overlay is turned off, and then repainted from the bottom to the top of the screen. This has the same effect as turning on the overlay display (F11).

SHIFT + F3 **Wipe Off Effect From Top to Bottom**

The screen will redisplay the current overlay if it is off, then it will begin removing the overlay from the top to the bottom of the screen. This has the same effect as turning off the overlay display (F10).

SHIFT + F4 **Wipe Off Effect From Bottom to Top**

The screen will redisplay the current overlay if it is off, then it will begin removing the overlay from the bottom to the top of the screen.

SHIFT + F5 **Set Double Size Character Height/Width**

Characters are set to double height/width, allowing 6 rows of 12 characters per row. If the screen already has more than 6 rows or 12 characters in a row, this key sequence will cause distortion on the display. (This is a limitation of the video controller.) The screen must either be in a 12-character-per-row, 6-line format, or must be cleared before using this key sequence.

SHIFT + F6 **Set Normal Size Character Height/Width**

Sets characters to the normal size, allowing 12 rows of 24 characters per row. This function is not available in Edit mode.

SHIFT + F7 **Overlay Display Blink On**

The overlay display will begin blinking.

SHIFT + F8 **Overlay Display Blink Of**

The overlay display will stop blinking if it is currently doing so. The overlay display will be left in the on state.

ENTER **Go to New Line**

Move to the first column of the next line on the display. If Edit mode is not active, this key is ignored.

← **(Back Space) Move Cursor Left and Erase**

If the cursor is in column 1 when the keystroke is received, it will move up to the end of the preceding line. If Edit mode is not active, this key is ignored.

← **Move Overlay Screen Position Left**

Moves the entire overlay screen to the left by 4 character dots. This is used for fine horizontal positioning of the overlay characters.

→ **Move Overlay Screen Position Right**

Moves the entire overlay screen to the right by 4 character dots.

↑ **Move Overlay Screen Position Up**

Moves the entire overlay screen up by 4 horizontal lines. This is used for fine vertical positioning of the overlay characters.

↓ **Move Overly Screen Position Down**

Moves the entire screen down by 4 horizontal lines.

power connector into J4. The display should initialize to the power-up default overlay screen which displays the titler's character set.

The character set is programmed into the 87C055 microprocessor's EPROM. The set contains alpha-numeric as well as some special characters. The characters can range from white with a black outline to black with a white outline. The characters are not reprogrammable. Once the characters are programmed in the EPROM of the microcontroller, they are fixed.

If a keyboard was chosen as the interface, it should be functional at this point. If a serial RS-232 interface was chosen, a banner should appear on the display of the connected terminal or PC.

Interfaces

With an IBM PC/AT keyboard attached, the user can simply type-in overlays and manipulate them in various ways. An interactive RS-232 interface provides a prompt that allows the entry of commands.

When using the keyboard interface, in addition to the standard alphanumeric keys, certain function keys are recognized. The function keys are outlined in Table 1. If you press the F1 key, the video titler will respond by clearing any overlay present and put a cursor in the upper left corner of the display in row 1, column 1. At this point, any of the character set keys shown in Table 2 can be typed.

When column 24 of any line is reached, the next character will roll to the next line in the column 1 position. When the cursor is at column 1, the backspace key will move the cursor back to column 24 of the previous line.

RS-232 serial interface

The RS-232 interface can be used in a Network or Interactive mode. It is, however, mainly meant to be used with the Interactive mode.

In the Interactive mode (NO), a "dumb" terminal can be at-

INTERFACE SELECTION

HDR1	JU4		Interface
I0	I1	I2	
In	X	X	Keyboard
Out	In	Out	RS232
Out	Out	In	RS485

X = DON'T CARE

WATCHDOG GENERATION

JU1	Function
In	Watchdog Timer Enabled
Out	Watchdog Timer Disabled

VIDEO ENPUT TERMINATION

JU2	Function
In	Video Input Terminated To 75 Ohms
Out	No Video Input Termination

RS485 TERMINATION

JU3	Function
In	RS485 Terminated To 100 Ohms
Out	RS485 Not Terminated

FIG. 5—JUMPERS MUST BE INSTALLED for JU1–JU4 and HDR1 according to the type of interface you are using.

```
1)    Pkut the Titler in Edit mode
2)    Send:          "THIS IS A TEST            "
                     " OF THE VIDEO             "
                     " TITLER                   "
3)    Exit the edit mode.
TERMO    >S=AOTHIS_IS_A_TEST\O_OF_THE_VIDEO\O__TITLER\A1<CRET>
                                          KEYS ENTERED
PROMPT
FROM TITLER
1)    Turn off the overlay display
2)    Put the Titler in Edit mode
3)    Send:          "  HELLO WORLD             "
                     "  THIS IS A TEST          "
4)    Exit the edit mode
5)    Wipe the message onto the screen from top to bottom
6)    Start the message flashing
TERMO    >S=\JO\AO _____HELLO_WORLD\O___THIS_IS_A_TEST\A1\KO\NO<CRET>
                                          KEYS ENTERED
PROMPT
FROM TITLER
```

FIG. 6—THE INTERACTIVE MODE is the easiest way to set up the Titler. Some examples in the RS-232 Interactive mode are shown here.

tached and commands can be given. In either case, jumpers must be installed on the board in the proper positions for the RS-232 interface selection (see Fig. 5 for details on setting the jumpers).

The pins on Header 1 (HDR1) marked S1–S4 are for connecting jumpers or external switches to activate certain functions. If external switches are going to be used, they should be of the normally open SPST-type. The switch inputs are read via the "Q" command from the serial interface. Only switch closures since the last Q command are reported.

The Interactive mode can be selected at power-up by closing the S2 contacts. It can also be selected from the Network mode by generating command N0. The interface can then be changed to RS-232 via jumpers and a "dumb" terminal can be attached.

When used in the Network mode, the address and optional checksum portion of the command string is required. If the Interactive mode is selected, the address and optional checksum are omitted. When the Interactive mode is selected, a sign-on screen will be sent to the terminal along with a prompt that indicates the Network address. The address defaults to TERM0 at the first power-up. The Interactive mode is the easiest way to set up the Titler. Some examples in the RS-232 Interactive mode are shown in Fig. 6.

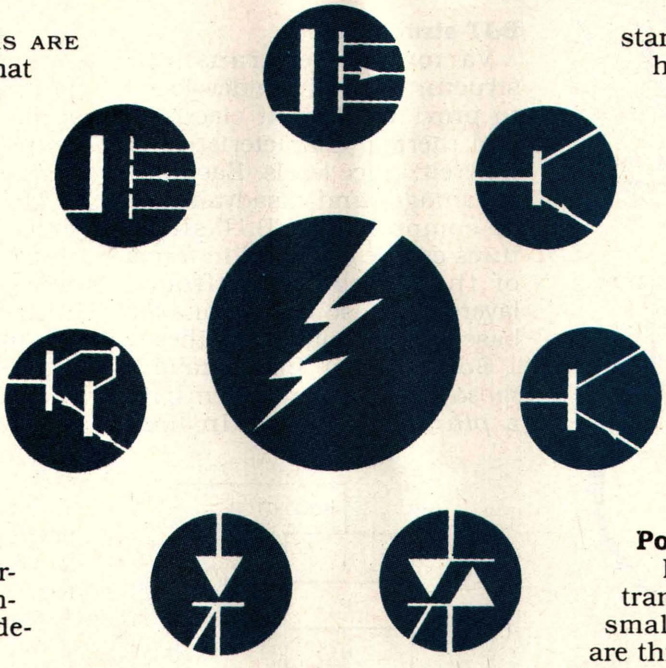
Power-up overrides

At power-up, certain override functions can be performed by closing S1 and S2. If S1 is closed at power-up, the titler will force all parameters to their defaults. This will put the video titler's default character set on the display, set the address of the unit to TERM0, and the mode of the unit will be Interactive. This is a good way of forcing a start from a defined point if everything else you try fails. If S2 is closed at power-up, the titler will assume Interactive mode of operation. This is equivalent to entering the "N0" command from the Network mode. Ω

TABLE 2—CHARACTER SET

Hex Value	ASCII Char.	Titler Function	Hex Value	ASCII Char.	Titler Function
00	NUL	Not Used	40	@	@
01	SOH	Not Used	41	A	A
02	STX	Not Used	42	B	B
03	ETX	Not Used	43	C	C
04	EOT	Not Used	44	D	D
05	ENQ	Not Used	45	E	E
06	ACK	Not Used	46	F	F
07	BEL	Not Used	47	G	G
08	BS	Not Used	48	H	H
09	HT	Not Used	49	I	I
0A	LF	Not Used	4A	J	J
0B	VT	Not Used	4B	K	K
0C	FF	Not Used	4C	L	L
0D	CR	Reserved in Serial	4D	M	M
0E	SO	Not Used	4E	N	N
0F	SI	Not Used	4F	O	O
10	DLE	Not Used	50	P	P
11	DC1	Not Used	51	Q	Q
12	DC2	Not Used	52	R	R
13	DC3	Not Used	53	S	S
14	DC4	Not Used	54	T	T
15	NAK	Not Used	55	U	U
16	SYN	Not Used	56	V	V
17	ETB	Not Used	57	W	W
18	CAN	Not Used	58	X	X
19	EM	Not Used	59	Y	Y
1A	SUB	Not Used	5A	Z	Z
1B	ESC	Not Used	5B	[	Not Used
1C	FS	Not Used	5C	\	Reserved in Serial
1D	GS	Not Used	5D	]	Not Used
1E	RS	Not Used	5E	^	Not Used
1F	US	Not Used	5F	_	Not Used
20	SP	Space	60	`	Not Used
21	!	Reserved in Serial	61	a	A
22	"	"	62	b	B
23	#	Reserved in Serial	63	c	C
24	$	$	64	d	D
25	%	%	65	e	E
26	&	&	66	f	F
27	'	'	67	g	G
28	(	(	68	h	H
29	)	)	69	i	I
2A	*	*	6A	j	J
2B	+	+	6B	k	K
2C	'	'	6C	l	L
2D	-	-	6D	m	M
2E	.	.	6E	n	N
2F	/	/	6F	o	O
30	0	0	70	p	P
31	1	1	71	q	Q
32	2	2	72	r	R
33	3	3	73	s	S
34	4	4	74	t	T
35	5	5	75	u	U
36	6	6	76	v	V
37	7	7	77	w	W
38	8	8	78	x	X
39	9	9	79	y	Y
3A	:	:	7A	z	Z
3B	;	;	7B	{	Not Used
3C	<	<	7C	|	Not Used
3D	=	=	7D	}	Not Used
3E	>	>	7E	~	Not Used
3F	?	?	7F	DEL	Not Used

POWER SEMICONDUCTORS



NEIL SCLATER

Semiconductors from transistors and thyristors to solid-state relays and integrated circuits have been designed to switch high currents and voltages, making them power devices.

POWER SEMICONDUCTORS ARE semiconductor devices that have been designed to handle or switch power. They include bipolar and field-effect transistors, thyristors, solid-state relays and a fairly new class of device called the power ICs.

There is no industry-accepted definition that will apply to all power semiconductors. However, most should be capable of passing at least 1 ampere of current or handling 1 watt of power during normal operation without being damaged or destroyed.

Some semiconductor devices are rated for handling voltages and currents that are far beyond those normally encountered in electronics. They are more properly classed as electrical power and distribution components, but there is no agreement on the boundaries between those classifications. They are best determined by their applications.

Many people think of power semiconductors as components found only in automotive, industrial, and military circuits, but they are now found in many consumer appliances, entertainment products, and business machines. Not so long ago it was easy to distinguish a power semiconductor device from a small-signal device—they were in metal cases.

Today, a surprisingly large number of mid- and low-range power devices are packaged in plastic cases because of the development of improved, low-cost plastic cases that will withstand thermal stress. Some have metal tabs that function both as heatsinks and mounting surfaces.

Power transistors

Three types of discrete transistors qualify as power transistors: power bipolar junction transistors (BJT), power bipolar Darlington transistors, and power MOSFETs.

Power bipolar transistors

Power bipolar junction transistors (BJT), like their small-signal counterparts, are three-layer, three-terminal devices formed by adding a second junction to a two-layer diode chip. Figure 1 is the schematic symbol for an NPN BJT; it is the same symbol as that for a small-signal BJT. Power BJTs also have emitter, base, and collector terminals. In normal operation, the emitter-to-base junction is biased in the forward direction, while the collector-to-base junction is reverse-biased.

Electrons flow from the emitter to the collector in all BJTs (opposite the flow of conventional current). However, the outward-pointing arrowhead in Fig. 1 shows the direction of conventional current. Figure 2 is the schematic symbol for a power PNP BJT. Here electron flow and conventional current are reversed. This can be seen from the inward direction of the arrowhead. (For more information on all BJTs refer to the September 1993 *Electronics Now*, page 57.)

Both kinds of power BJTs are

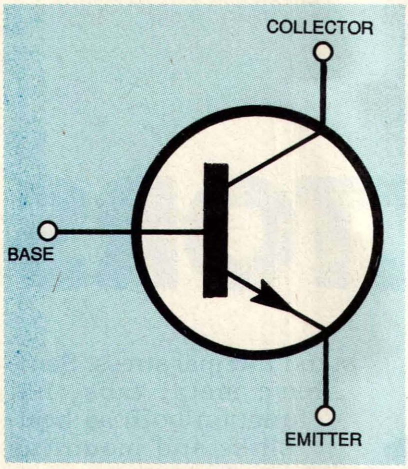


FIG. 1—SCHEMATIC SYMBOL for an NPN power bipolar junction transistor (BJT).

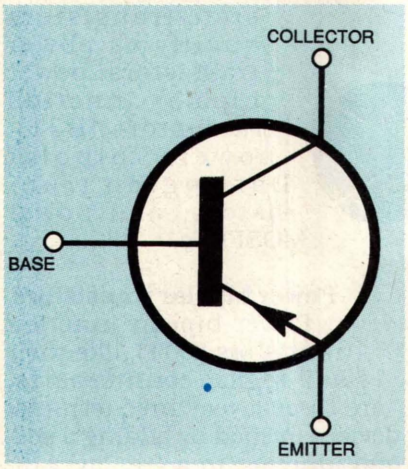


FIG. 2—SCHEMATIC SYMBOL for a PNP power bipolar junction transistor (BJT).

made as two parallel PN junctions with controlled spacing between their junctions and controlled impurity levels on both sides of each junction. This is shown in Fig. 3, the functional diagram for an NPN showing the polarities for conventional operation.

In power BJTs, *structure* refers to the junction depth, the concentration and profile of the impurities (doping), and the spacing of the various levels of the device. Figure 4 is a cross-section view of an NPN BJT formed as a vertical silicon structure. The collector terminal is at the base of the chip, but both the base and emitter terminals are on the top.

The term geometry refers to the topography of the transistor, that is, the way the various doped parts of the transistor are formed on the silicon chip or die.

The applications for power BJTs are influenced by their structure, geometry, and packaging. When selecting a power BJT, the circuit designer must consider gain, frequency, voltage, current, and the heat dissipation characteristics of the device.

BJT structures

Various power transistor structures have been developed to provide different electrical and thermal characteristics at different price levels. Each has advantages and disadvantages or compromises. BJT structures can be classified in terms of the number of diffused layers, the use of an epitaxial base, or combinations of these.

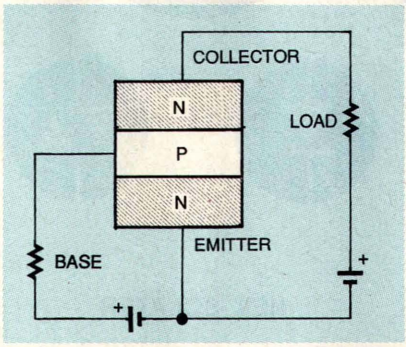


FIG. 3—FUNCTIONAL DIAGRAM of an NPN power bipolar junction transistor (BJT).

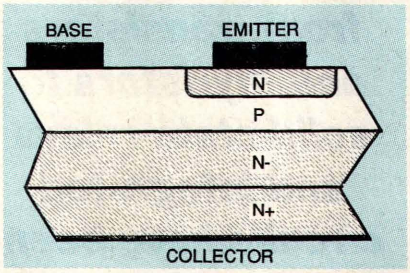


FIG. 4—SECTION VIEW of an NPN power bipolar junction transistor (BJT) with a vertical structure.

Some power BJTs have a *mesa* structure and others have a *planar* structure. In textbooks and manufacurers' data books you will see references to specific structures:

1. Single-diffused (hometaxial)
2. Double-diffused (mesa, planar, epitaxial mesa, planar mesa, and multiple epitaxial mesa)
3. Triple-diffused (mesa and planar)
4. Epitaxial-base (mesa)
5. Multiple-epitaxial base (mesa)

A discussion of these structures and how they are formed is beyond the scope of this article. However, each of these structures has its own set of characteristics that make them suitable for handling high voltages, current, and power. Some structures are best suited for power switching while others function better as large-signal amplifiers including radio frequency (RF) amplification.

There also economic considerations. Some structures cost more to manufacture than others and this is reflected in their pricing. If a metal case is required, or a wider operating temperature is needed, expect to pay more for the device.

Power BJTs are specified in terms of the following parameters:

1. Voltage rating, collector-to-emitter.
2. Current rating of the collector.
3. Power rating.
4. Switching speed.
5. Direct-current gain.
6. Gain-bandwidth product.
7. Rise and fall times.
8. Safe operating area (SOA).
9. Thermal properties.

Power switching BJTs

The popularity of the switching or switchmode power supply has created a heavy demand

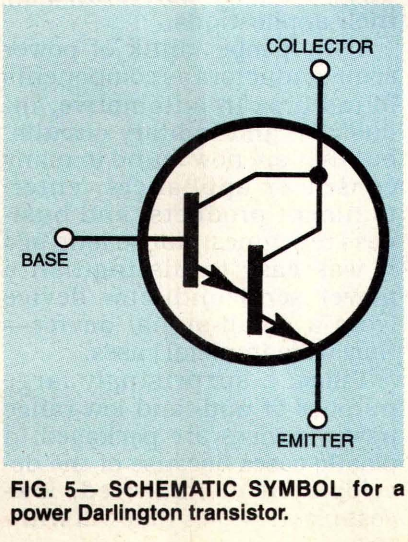


FIG. 5— SCHEMATIC SYMBOL for a power Darlington transistor.

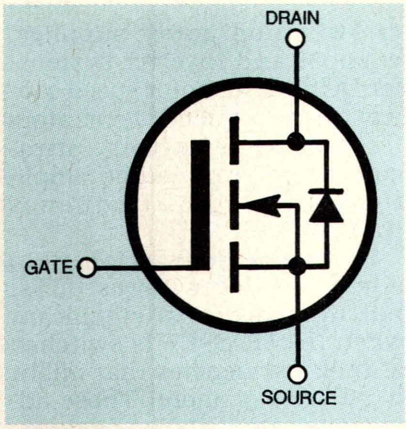


FIG. 6—SCHEMATIC SYMBOL for an N-channel power MOSFET.

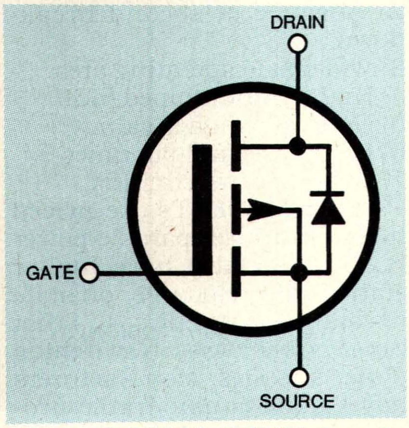


FIG. 7—SCHEMATIC SYMBOL for a P-channel, enhancement-mode power MOSFET.

for power BJTs that are capable of switching at frequencies greater than 10 kHz. To qualify for switchmode power supplies, the power BJT must be able to withstand voltage that is typically twice the input voltage.

The BJT must have a collector current rating and safe operating area (SOA) that are high enough to prevent the device from being damaged or destroyed in its intended application. The SOA quantifies the ability of the power BJT to handle high currents and voltages simultaneously.

A power BJT operated at high power densities can fail due to second breakdown. This occurs when current concentrates in a small area of the chip, causing its temperature to rise rapidly. The emitter-collector voltage could drom more than 10 volts. Input power must be shut down quickly when second breakdown to prevent the BJT from being damaged or destroyed.

Darlington power transistor

Figure 5 is the schematic symbol for a Darlington power transistor. A Darlington power transistor consists of two bipolar power transistors on a single chip that are DC coupled internally as emitter followers. Because they are packaged in discrete cases with three pins, they look like conventional power BJTs. Power Darlingtons offer higher input resistance and current gain than individual BJTs.

Power MOSFETS

Power MOSFETs are metal-oxide semiconductor field-effect transistors made to handle higher current and power than small-signal MOSFETs. Like small-signal MOSFETs, power MOSFETs are voltage-controlled devices; they have the same three electrodes: source, gate, and drain.

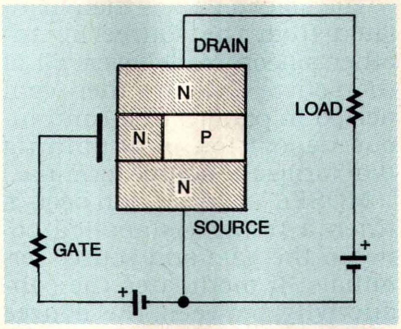


FIG. 8—FUNCTIONAL DIAGRAM of an N-channel, enhancement-mode power MOSFET

Figure 6 is the schematic symbol for an N-channel, enhancement-mode MOSFET power transistor. This schematic symbol differs from the small-signal MOSFET symbol in that it has a diode connected between its source and drain.

However, as in the small-signal MOSFET symbol, the direction of the arrow indicates the direction of conventional current flow. The broken lines representing the source to drain channel indicate that it is an enhancement-mode device. This means that it is a "normally off"device. Electrons flow from the source to the drain in an NPN MOSFET when the channel is enhanced or correctly biased.

Figure 7 is the schematic symbol for a P-channel, enhancement-mode power MOSFET. Again, as in the NPN transistors, the flow of electrons and the flow of conventional current are reversed. This can be seen from the direction of the arrowhead representing conventional current flow. (For more information on MOSFETs, both enhancement- and depletion mode, see the May 1993 *Electronics Now*, page 59.)

Figure 8 is a functional diagram for a N-channel, enhancement-mode MOSFET that is better for explaining the operation of the device. Voltage applied across the gate and source causes current to flow to the drain. The gate, as in all MOSFETs, is isolated from the source by a layer of insulating silicon oxide. With no voltage between the gate and source electrodes, the impedance between the gate and source is high and no current flows.

Figure 9 is a simplified section view of the structure of a typical power MOSFET. Unlike the planar structure of small-signal MOSFETs, most power MOSFETs today are made as vertical structures. The drain is the substrate body and its terminal is a metallized layer on the bottom. The gate and source are deposited on top of the drain structure like icing on a cake.

Most power MOSFETs today are made by the double-diffused vertical DMOS process. (It is a MOS manufacturing process involving two-stage diffusion of impurities through a single mask opening.) This geometry

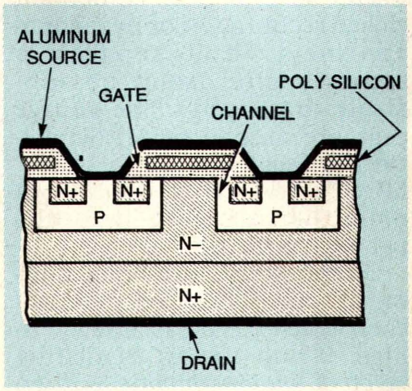


FIG. 9—CROSS-SECTION of the structure of an N-channel power MOSFET.

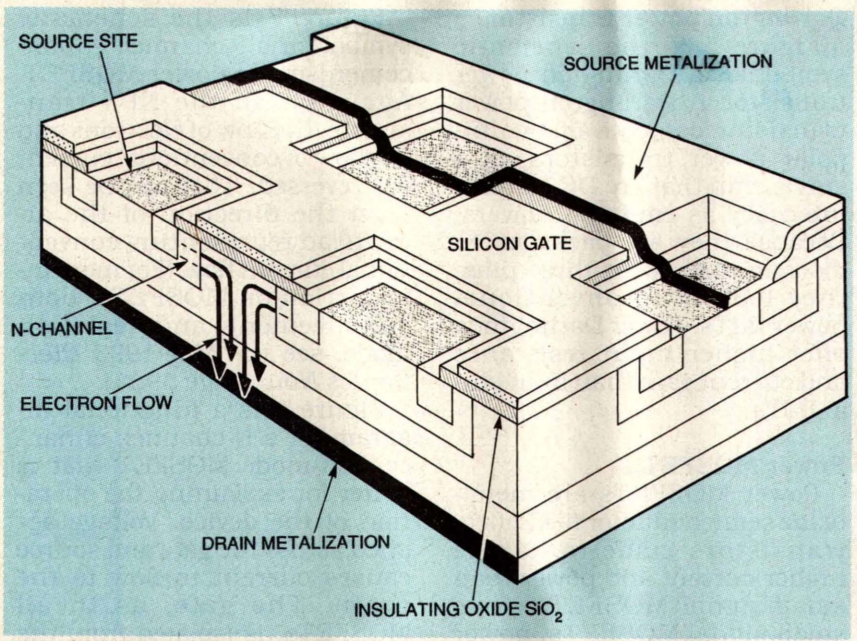


FIG. 10—CUTAWAY VIEW OF A DMOS power MOSFET. The current flows vertically from the drain to the source.

and structure has replaced the V-groove or VMOS process widely used in the 1970s.

The term vertical refers to the vertical flow of current between the drain and source as opposed to the flow of current in horizontal channels in small-signal MOSFETs and CMOS ICs.

Power MOSFET geometry.

To gain more uniform current distribution throughout the power MOSFET chip, manufacturers have developed various mesh or honeycomb gate and source structures for the upper surfaces of the chip. They define the multiple gates and sources. Figure 10 is a cutaway view of a typical power MOSFET made by the DMOS process.

The source cells consist of closed rectangular or hexagonal channels which separate a source region from the substrate drain body. The source cells are formed by an deposition process and some power MOSFETs have a density of more than a half-million cells per square inch.

Channels are formed by double diffusion at the periphery of each source cell, as shown in Figs. 9 and 10. An insulating layer of silicon dioxide is then deposited over all of the channels. A polysilicon gate pattern is deposited on top of both the insulating oxide and channel.

The silicon gate is then insulated from the source by another silicon oxide layer. All of the source cells are then connected in parallel by a continuous deposition of aluminum that forms the source terminal.

MOSFET conduction occurs when a voltage is applied between the gate and source terminals; it modulates the conductivity between the source and drain. Electrons flow from a source cell through the channel around the outside of the cell and then into the drain body.

The lower metallized surface of the drain substrate forms a conductive electrical and thermal contact with the header or mounting surface within in the device case.

International Rectifier Corp.,(IRC) developed power MOSFETs with hexagonal gate cells that HEXFETs to highlight the manufacturing process. However, Motorola Semiconductor developed rectangular gate cells, but its MOSFETs are called TMOS, a name that suggests the T-shaped flow of current in the device. This is seen in Fig. 10. Other manufacturers refer to their power MOSFETs by their own proprietary names.

Typical applications for power MOSFETs are in high-frequency switching power supplies, chopper and inverter systems for DC and AC motor speed control, high-frequency generators for induction heating, ultrasonic generators, audio amplifiers and radio- frequency transmitters.

Power MOSFETs have certain advantages over power BJTs, but these are most significant when the MOSFET is switched at high frequencies that might be 40 kHz or more. Those advantages are:

1) Faster switching speed and lower switching losses.
2) Absence of second breakdown.
3) Wider safe operating area.
4) Higher input impedance.
5) Generally higher gain.
6) Faster rise and fall times
7) Simpler drive circuitry

Power MOSFETs are priced higher than comparable power BJTs. They also have higher static drain-to-source, on-state resistance values ($R_{DS(ON)}$) that cause power losses in switching power supplies. Manufacturers have made considerable progress in reducing these values by improving their manufacturing techniques.

Power transistor packages

As in other power devices, the packaging of power transistors is influenced by the device's current ratings. The most popular case for all power transistors rated 15 amperes or less is the plastic TO-220 package. Power transistors with higher rating are packaged in metal TO-3 and TO213 metal cases among others. More recently, power transistors have been packaged in various small-outline, surface-mount cases such as the SO-8.

Thyristors defined

Thyristors are a class of gate-controlled semiconductor power rectifiers formed from four or more alternate layers of P- and N-doped silicon. The most familiar thyristors are the silicon controlled rectifier (SCR) and the bidirectional triode thyristor or triac. Less familiar are the GTO and diac.

All of these devices behave

like conventional PN rectifiers in the presence of current passing in the reverse direction and as combination switch/rectifiers in the presence of current in the forward direction.

Controlled rectifier

The silicon controlled rectifier (SCR) is a four-layer PNPN thyristor that switches load currents in one direction only. This makes it useful for switching DC as well as half-wave and full-wave AC power. Figure 11-a shows the schematic symbol for the SCR and Fig. 11-b is a section view of its layered structure. The SCR has three junctions and three terminals; anode, cathode, and gate.

The SCR is fundamentally a rectifier diode with a control element called the gate. The anode-to-cathode voltage at which the SCR starts to conduct is determined by the current flowing in the gate electrode. The gate bias can hold the SCR off, or it can permit conduction to begin at any point in the forward half cycle of AC across the anode and cathode terminals.

The SCR anode voltage must be positive for conventional forward-biased operation. The SCR is turned on by placing a positive voltage on the gate electrode. Once it is turned on, the SCR remains on—even if its gate voltage is cut-off or made negative.

The anode-to-cathode voltage must be reduced to the threshold level or the forward current must be reversed. Also, if the SCR is switching AC, the AC must cross the zero level.

In most applications, the SCR switches currents in only one direction. SCRs can also function as controlled rectifiers in high-power bridges. Heavy-duty SCRs can handle hundreds of amperes and peak voltages as high as 1500 volts with triggering currents of a few milliamperes.

Most SCRs specified for electronics circuits are rated for 40 amperes or less. Those with higher ratings typically serve in electrical power generation, distribution, and contol applications.

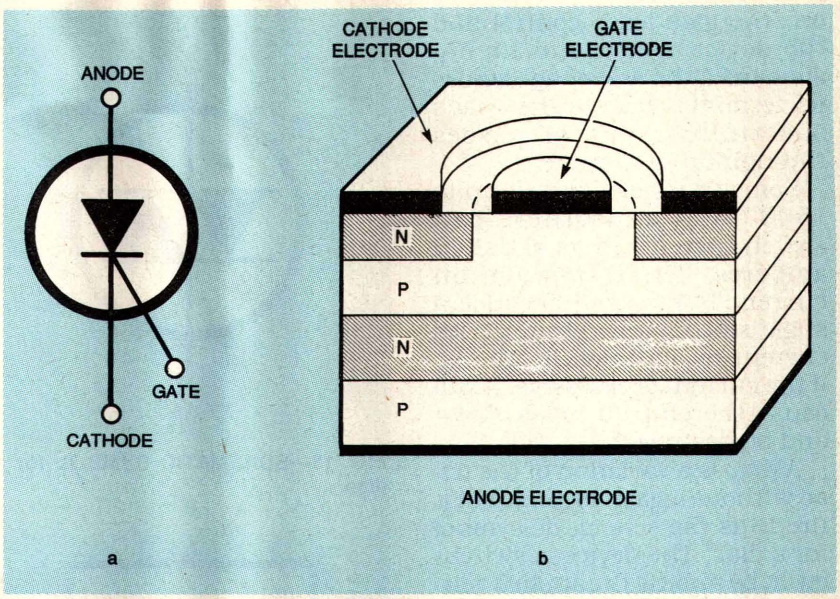


FIG. 11—SCHEMATIC SYMBOL for a silicon controlled rectifier (a), and a sectional view of an SCR chip (b).

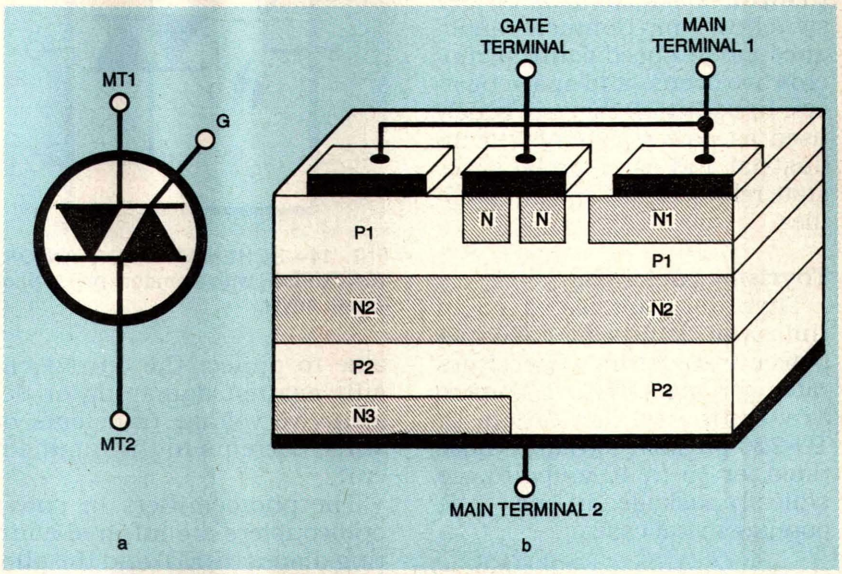


FIG. 12—SCHEMATIC SYMBOL for a triac (a), and a sectional view of a triac chip.

The gate turn-off rectifier (GTO) is a variation on the SCR. It can be turned off with a negative bias applied to its gate terminal.

Bidirectional thyristors

A triac is a bidirectional thyristor that can be turned on for load current in either direction. Figure 12-a is the schematic symbol for a triac and Fig. 12-b is a diagram of the triac's five-layer, four junction NPNPN structure. It acts like two inverse-parallel connected SCRs. A single-gate electrode turns the device on for current in both directions.

A triac is also called a gated symmetrical switch. Because triacs are bidirectional, they are widely specified for switching AC. Unlike an SCR, a triac need not be preceded by a bridge rectifier to switch full-wave AC. The electrodes of the triac are the main terminals 1 and 2, and the gate.

When a positive voltage is applied across the main terminals, a positive pulse at the gate will trigger the device into forward conduction; when a negative voltage is applied, a negative gate pulse will trigger the device into reverse conduction. Once a triac is turned on, the gate loses control and the device remains in its on-state until the AC voltage across its terminals falls to the triac's sustaining value or passes through the zero value.

Some triacs can switch up to 1500 volts and others can switch currents up to about 40 amperes. The restriction on current is imposed because a sngle silicon triac chip carries current in opposite directions. If the current is excessive, it will cause the chip to break down and be destroyed.

A diac is a variation of the triac without a gate terminal. Figure 13 is the schematic symbol for a diac. The device is switched on by raising the applied voltage to the breakover voltage.

Triacs are found in consumer products including power switches, lamp dimmers, appliance motor speed controls, microwave ovens, and space heaters. In addition, they are widely used as power switches in industrial and commercial solid-state relays and AC output modules.

Thyristor packaging

Thyristors are packaged in the same kinds of cases as power transistors. Thyristors rated for more than 1 ampere are typically packaged in TO-220 plastic cases and those rated for 15 to 40 amperes are typically packaged in one of the popular metal cases.

Optocouplers

An optocoupler, also known as an optoisolator is a semiconductor device consisting of a photoemitter, a short optical transmission path and a photodetector in the same package, typically a DIP. Optocouplers are capable of converting an electrical input signal to modulated light and restoring it to an electrical signal.

The only optocouplers discussed here are those with thyristor drivers. (For more complete information on optocouplers, see the August 1992 *Electronics Now*, page 44.)

All optocouplers provide electrical isolation between the input and output circuits and are able to protect the output circuit against damaging or destructive voltage transients or surge currents in the input circuit.

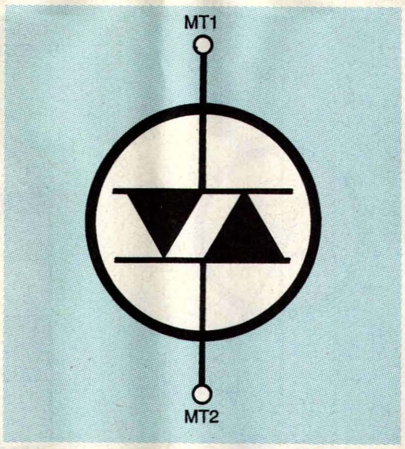


FIG. 13—SCHEMATIC SYMBOL for a diac.

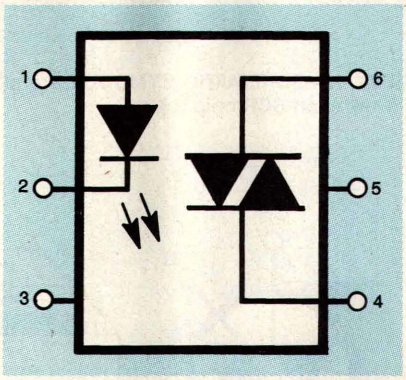


FIG. 14—SCHEMATIC FOR AN OPTOCOUPLER with a random phase phototriac driver.

The photoemitters in power optocouplers are infrared-emitting diodes (IRED) and the photodetectors can be photoSCRs or phototriacs. As in other couplers, these optothyristors are matched to the output of the IRED. The photoSCR can switch direct current and the phototriac can switch alternating current

Figure 14 is the schematic for an optocoupler with a triac driver and Fig. 15 is the schematic for an optocoupler with a zero crossing triac driver. When not receiving an electrical input, the IRED and photothyristor are normally "off." The input signal across the IRED terminals causes it to emit infrared energy that is transmitted through a short glass or plastic waveguide to the photothyristor.

Light energy incident on the photoSCR or phototriac causes it to generate an electrical output. Both photothyristors responds to input signals that might be short pulses. The internal zero-crossing circuit switches the triac only at zero crossings of the AC.

Optocoupler packaging.

All optocouplers are packaged in opaque cases to prevent the entry of extraneous light that could interfere with signal transmission. The most popular commercial/industrial optocouplers are packaged in standard six-pin dual-in-line (DIP) packages, but there is increasing demand for surface-mountable, gull-wing lead cases.

The accepted industry standard for electrical isolation (V_{ISO} is about 5000 volts AC peak, but Motorola offer optoisolators with ratings of 7500 volts. Most manufacturers seek the UL recognition as well as approval by CSA, VDE, DIN and other regulatory agencies for their products because they can switch AC line power.

Solid-state relays

A solid-state relay (SSR) is an electronic circuit that includes a signal-level trigger circuit coupled to a power semiconductor switch, either a transistor or thyristor. The term SSR is widely understood to mean a factory-made and tested product rather than a solid-state relay function built from separate components on a PC board by the user.

The SSR differs significantly in both structure and operation from the coil-and-contact electromagnetic relay (EMR). However, both provide power gain. The input circuit of an SSR might be an optocoupler, reed relay, or transformer. It is analogous to the "coil" of an EMR, and it is electrically isolated from the power semiconductor switch that acts as the "contact."" SSRs require only relatively low energy control circuits to switch the output power.

SSRs for switching alternating current require either two inverse-parallel (back-to-back) silicon controlled rectifiers (SCR) or an electrically equivalent triac. However, if direct current is to be switched, the switching device is either a bipolar or MOSFET transistor.

The classification of an SSR is based on its input circuit or method for achieving input-output (I/O) isolation. True SSRs achieve electrical isolation between the input and output circuits with optocouplers. Figure 16 is the block diagram of an optically-coupled, solid-state relay with zero-voltage triggering of a triac for switching an AC load. However, hybrid solid-state relays for have reed relays or transformers for isolation.

Solid-state relays have many advantages over electromechanical relays. These advantages include:

1. Longer life and higher reliability.
2. Ease in matching logic-level circuits.
3. Higher-speed switching.
4. High resistance to shock and vibration.
5. Absence of mechanical contacts.

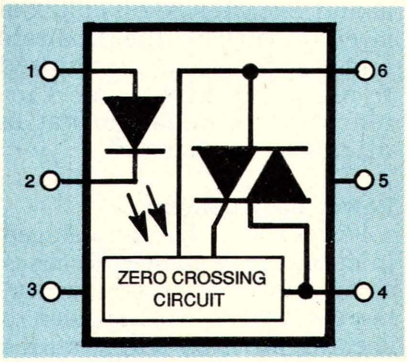


FIG. 15—SCHEMATIC FOR AN OPTOCOUPLER with a zero-crossing triac driver.

The absence of mechanical contacts eliminates: contact bounce, arcing due to contact opening, electromagnetic interference (EMI), and fire or explosion hazards that would be caused by contact arcing in the presence of explosive or flammable gases, liquids or solids.

However, electromechanical relays are more cost effective in many applications that do not call for high-speed switching or operation in a hazardous environment. Many small sensitive electromechanical relays can be switched at TTL logic level.

Solid-state relays can be classified in five general groups:

1. AC power relays capable of switching 24 to 530 volts AC at 2 to 75 amperes with DC input (typically 3 to 32 volts) or AC input (typically 90 to 280 volts) with triacs or dual, back-to-back SCRs.
2. DC power relays, capable of switching 100 to 500 volts at 7 to 40 amperes under DC control with power transistors.
3. AC low-power relays, for PC-board mounting, capable of switching 60 to 240 volts at 0.3 to 4 amperes with triacs.
4. DC low-power relays, for PC-board mounting, capable of switching up to 60 volts at 3 amperes with power transistors.
5. Input-output modules, specialized miniature low-power AC and DC relays for PC-board mounting. They are widely used for interfacing computer systems and industrial controls with external sensors and actuators.

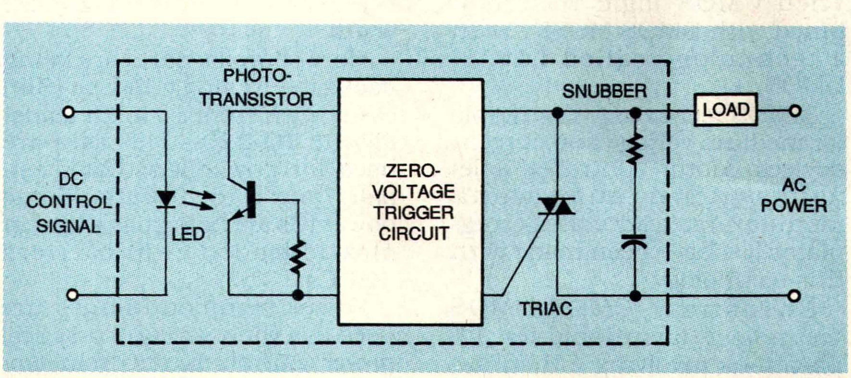


FIG. 16 —SCHEMATIC OF A SOLID-STATE AC RELAY with zero-crossing. The triac permits the relay to switch AC directly.

AC solid-state relays

The most popular AC power relays with ratings of 2 to 75 amperes are packaged in four-terminal, rectangular flatpacks suitable for panel or heatsink mounting. They have three functional sections as shown in Fig. 16: an optoisolator, a zero-voltage detector and a triac.

The zero-voltage detector assures that the thyristor will be triggered only when the AC voltage crosses the zero reference (in either the negative or positive direction) to minimize the effect of surge currents at the time the thyristor is switched.

Surge currents can result from switching tungsten-filament incandescent lamps and capacitive loads. For example, the cold resistance of a tungsten lamp is less than 10 % of its illuminated resistance.

If the SSR is turned on when the voltage is not at a zero crossing, the high instantaneous load current drawn by the lamp could destroy the SSR. The thyristor, once triggered, will not stop conducting until the load current it is conducting falls to zero.

A resistor and capacitor in series, called a snubber, bypasses voltage transients that occur with inductive loads when current and voltage are out of phase. Triacs are the thyristor of choice in general purpose AC relays for ratings up to 10 amperes at 120 to 240 volts. Dual SCRs are capable of switching AC power loads in excess of 40 kilowatts.

Important specifications for AC SSRs include:

1. Isolation voltage.
2. Operating temperature range.
3. Control signal range.
4. Must-operate voltage.
5. Must-release voltage.
6) Input current.

UL recognition and CSA approval are commonly obtained for all factory-made power SSRs for use in the United States and Canada. But there is an increasing demand for SSRs made by North American manufacturers that meet the European VDE and DIN standards so that they

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SS relay packaging.

The standard industry-accepted package for for AC SSRs worldwide rated 2 to 40 amperes is a rectangular flatpack that measures 2¼ × 1¾-in × 0.9-inches. Its four screw terminals permit the relay to installed (or replaced) in the field by forming hooks in the ends of the connecting wires and clamping the wires tightly with the screws.

SSR for switching direct current include optocouplers for isolation and power MOSFET drivers. The are also packaged in the flatpack cases but there is no real standardization of DC SSR package style.

Power integrated circuits

A power integrated circuit is a monolithic IC with signal-level analog circuitry or digital logic circuitry on the same chip with one or more power transistors. These ICs are capable of handling 2 amperes or 2 watts. The first commercial power ICs were drivers for high-voltage neon gas-discharge seven-segment displays. They combined bipolar digital logic with a bipolar power transistor on the same chip.

Later power ICs were made with mixed bipolar and metal-oxide semiconductor (MOS) technologies, and analog circuitry was added. CMOS logic was combined with bipolar transistors in a fabrication process called BIMOS technology. Then CMOS logic was combined with DMOS MOSFETs in a technology called CMOS/DMOS.

BIMOS technology is suitable for medium voltage and current devices. Motor controller, solenoid switcher, pulse-width modulators, and voltage regulator ICs have been made with this technology.

By contrast, CMOS/DMOS technology is suitable for applications involving either low-voltage, high-current, fast-switching or high-voltage, low-current, fast-switching ICs. Display drivers have been fabricated with CMOS/DMOS technology.

Three different techniques are used to isolate the control circuitry from the power device on the monolithic IC chip to prevent interference and electrical breakdown of the device. These are:

1. Self-isolation, an extention of CMOS technology. The reverse-biased junction is located between the source and the drain region. This technique is usually limited to devices drawing less than 2 amperes, but voltage can be as high as 500 volts.

2. Dielectric isolation (DI) employs single-crystal islands or "tubs" grown on a polysilicon substrate for locating the IC functions. Because current must be brought out of the top of the circuits within the tub, the voltage levels are limited. It is said to produce the lowest parasitic capacitance and permit full isolation on the chip.

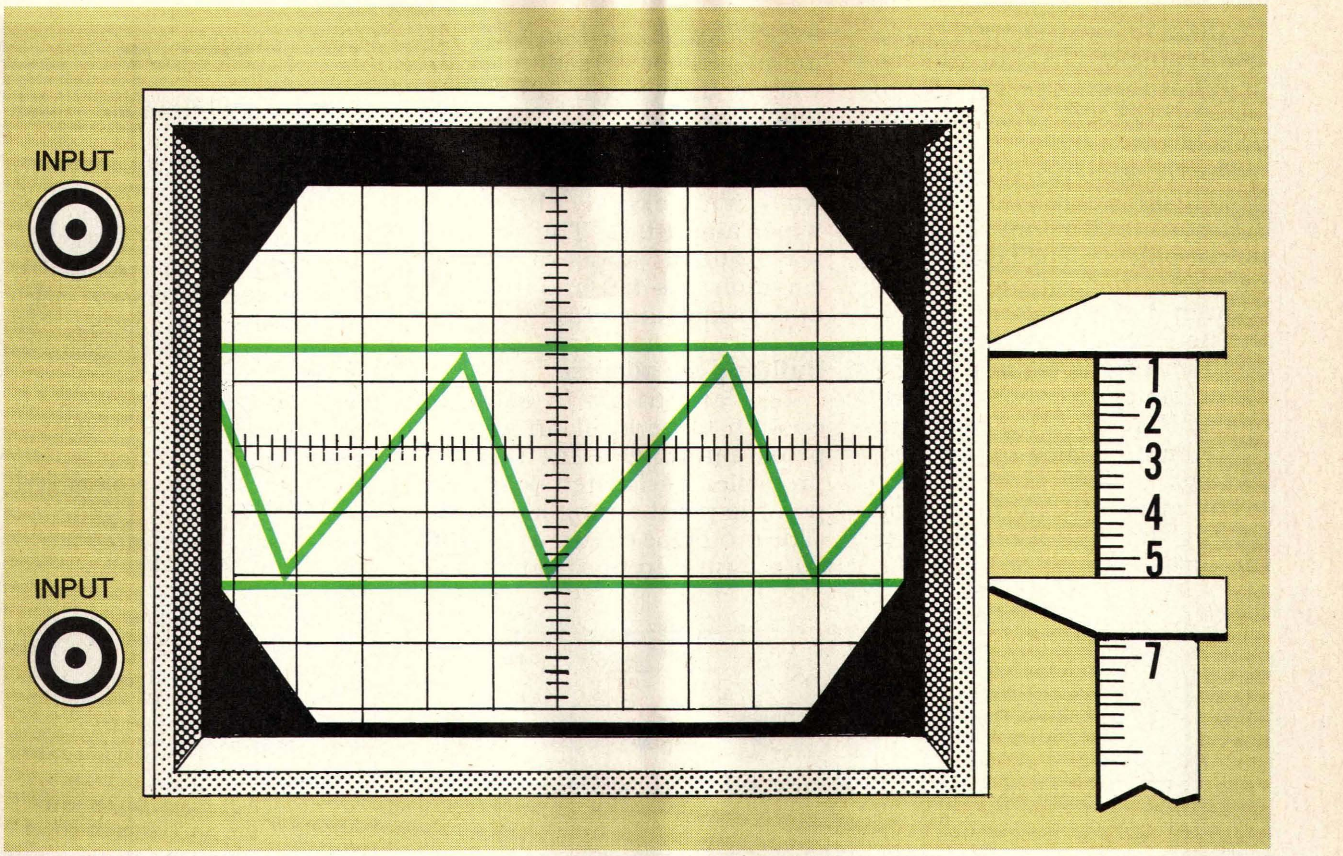
3. Junction isolation (JI) permits the formation of both lateral and vertical ICs. An epitaxial layer is formed on the substrate and deep junctions are diffused to obtain isolated areas. Current flow is similar to that in discrete power devices.

Power IC packaging

Power ICs are being packaged in many of the same style cases as conventional ICs. However, more attention is being given to keeping junction temperatures below set limits. These include DIP cases with 8 to 28 pins and small outline (SO) cases where dissipated power is less than 2 watts.

More complex parts are being packaged in single-in-line (SIP) cases with from 11 to 23 leads. Plastic TO-220-style cases are used for power ICs that dissipate from 5 to 10 watts. Some power ICs are being packaged in plastic leaded chip carriers (PLCCs).

Power semiconductors are used in a wide variety of practical power control circuits, from simple switches to thermostatically controlled heaters. Ω



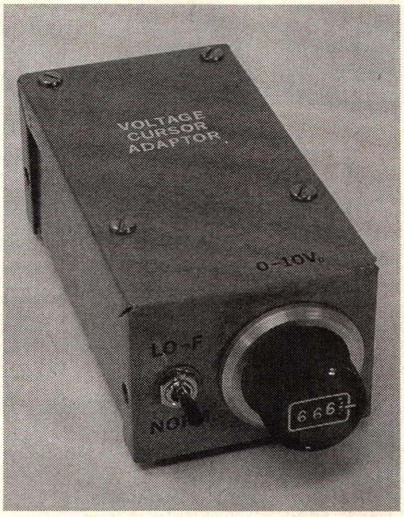
VOLTAGE CURSOR ADAPTER

Measure the voltage values of waveforms accurately and easily on your oscilloscope with the Voltage Cursor Adapter.

SKIP CAMPISI

HAVE YOU EVER HAD TROUBLE MEASURING the voltage value of a waveform on an oscilloscope screen? Are you tired of counting graticule squares and "guesstimating" those values? If so, you need the Voltage Cursor Adapter, It superimposes horizontal cursor lines on the top and bottom of the waveform—a kind of electronic calipers—to permit direct readout of the voltage value. The cursor lines extend across the entire screen.

The lower cursor (think of it as the floor) is the *zero-volt cursor* and the upper cursor (think of it as the ceiling) is the precision DC *reference voltage*. The cursors can be placed on any parts of the waveform that you want to measure, and the voltage can be read directly from a turns counter coupled to a precision potentiometer.



THE CURSOR ADAPTER superimposes horizontal cursor lines on the top and bottom of a waveform.

Figure 1 is the schematic diagram for the voltage cursor adaptor. The required 15 to 25-volt power to the circuit can be supplied either by batteries or a wall-mounted AC to 15-volt DC adapter. The author's prototype has a jack that will accept a plug from either the adapter or a battery pack consisting of two 9-volt batteries taped together.

The MC78L12 voltage regulator (IC1) supplies regulated 12-volts DC to the rest of the circuit. The ICM7555 timer (IC2), a CMOS version of the industry-standard 555, drives the CD4066B, a CMOS bilateral switch (IC3). This drive frequency can either be a normal frequency (NORM) of 100 Hz or a low-frequency (LO-F) of 10 kHz, depending on the setting of switch S1. Set S1 to LO-F for inputs below 500 Hz.

The DC reference voltage supplied to pin 3 of IC3 is set by R3, a 10-turn, 5000-ohm precision potentiometer. The voltage can be read directly from a turns counter dial coupled directly to the potentiometer's wiper. The accuracy of this reading can be 1% or better. Trimmer potentiometer R1 permits the voltage to R3 to be calibrated to precisely 10 volts.

The circuit is calibrated by setting the digital reading on the turns counter of R3 to the full clockwise position and adjusting R1 for a reading of 10 volts at the wiper of R3 with a digital voltmeter.

Bilateral switch IC3 converts the DC reference to a squarewave with exactly the same wiper amplitude. The squarewave output appears on the common pins 4, 9, and 10 of IC3 and coaxial plug PL1.

Building the adapter

The circuitry is simple enough to be built on an approximately 2 × 3-inch stock predrilled perforated board by point-to-point wiring methods. (The prototype circuit was built on a multipurpose board from Radio Shack.) There is nothing critical about component selection or placement. Figure 2 is a guide for positioning components on the circuit board.

The prototype was mounted in a two-part aluminum case that measured approximately 4 by 2 by 1⅝ inches. If you intend to put the circuit in similar project case, use the blank circuit board as a pattern and mark the hole locations on that part of the case with the ends folded up.

It is recommended that both

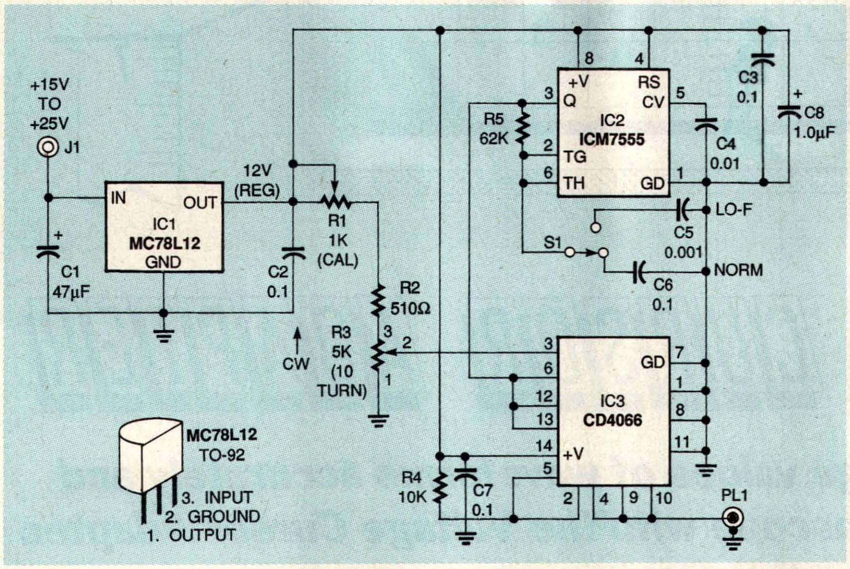

+15V
TO
+25V
J1
IN
OUT
IC1
MC78L12
GND
+
C1
47μF
12V
(REG)
C2
0.1
R1
1K
(CAL)
R2
510Ω
R3
5K
(10
TURN)
CW
3
2
1
MC78L12
TO-92
3. INPUT
2. GROUND
1. OUTPUT
R5
62K
8
4
+V
RS
3
Q
CV
5
IC2
ICM7555
2
TG
6
TH
GD
1
C3
0.1
+
C8
1.0μF
C4
0.01
LO-F
C5
0.001
S1
NORM
C6
0.1
3
6
12
13
14
5
+V
IC3
CD4066
GD
7
1
8
11
2
4
9
10
R4
10K
C7
0.1
PL1

FIG. 1—SCHEMATIC DIAGRAM for the voltage cursor adapter. Power can be supplied by batteries or an AC adapter.

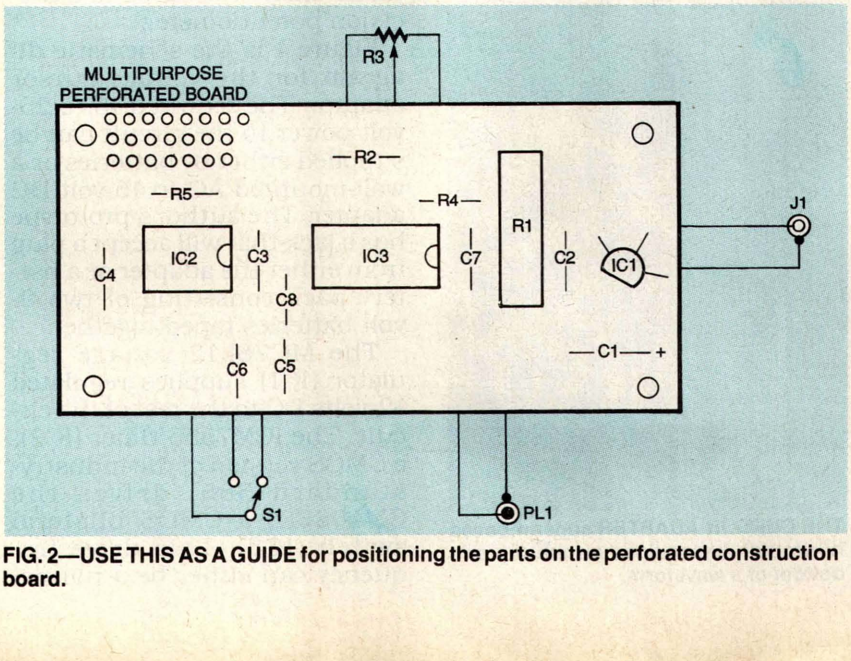

R3
MULTIPURPOSE
PERFORATED BOARD
R2
R5
R4
R1
J1
IC2
C3
IC3
C7
C2
IC1
C4
C8
C1
+
C6
C5
S1
PL1

FIG. 2—USE THIS AS A GUIDE for positioning the parts on the perforated construction board.

PARTS LIST

Resistors: all fixed are ¼-watt, 5%
R1—1000-ohm multiturn trimmer potentiometer, Bourns 3005P 101 or equiv.
R2—510 ohms
R3—5000-ohm, ⅞in. precision potentiometer, ten-turn with matching multiturn dial, Clarostat 73JB with a 15-turn dial or equiv. (See text)
R4—10,000 ohms
R5—62,000 ohms
Capacitors
C1—47μF, aluminum electrolytic, 35 VDC
C2, C3, C6, C7—0.1μF, ceramic
C6—0.1μF, polyester
C4—0.01μF, ceramic
C5—0.001μF, polyester
C8—1.0μF, solid tantalum dipped
Semiconductors
IC1—MC78L12 12-volt voltage regulator, Motorola or equiv.
IC2—ICM7555 CMOS timer, Harris or equiv.
IC3—CD4066B CMOS quad-bilateral switch, Harris or equiv.
Other components
S1—SPDT switch, miniature, panel-mounted, 3A
J1—coaxial jack, panel-mounted (to mate with power plug)
PL1—panel-mounted phone plug ⅛-inch dia.
Miscellaneous: multipurpose perforated board $1\frac{27}{32} \times 2\frac{27}{32}$ (Radio Shack 276-150 or equiv.); project case, aluminum, 4 × 2⅛· 1⅝in. (Radio Shack 270-239 or equiv.); one 8 pin DIP socket and one 14-pin DIP socket; four standoffs with screws, 11/16 inch; two 9-volt batteries with two snap connectors and attached plug or wall-mounted line AC to 15-VDC adapter, 50 mA; insulated hookup wire; solder; screws.

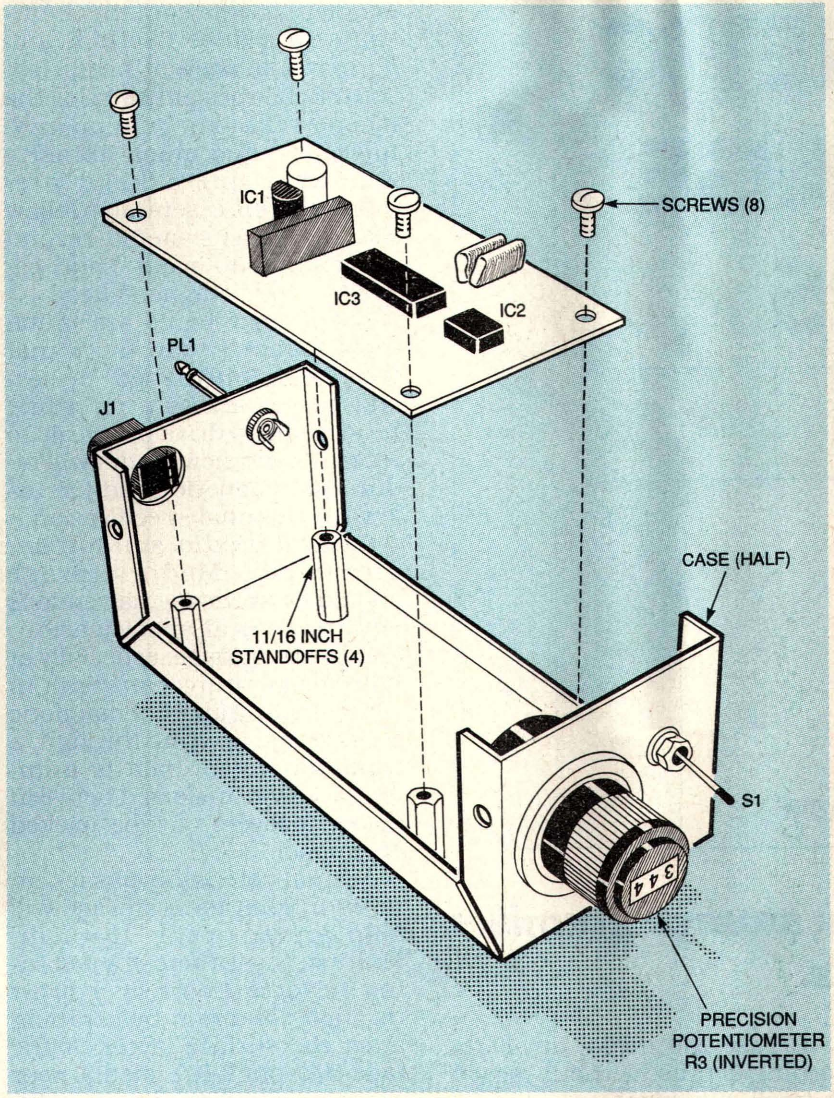
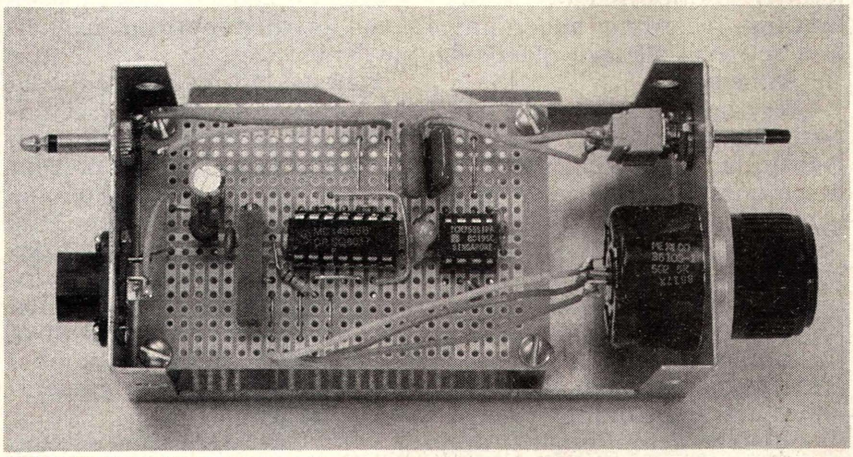


FIG. 3—HERE'S HOW EVERYTHING MOUNTS inside the case.



EVERYTHING FITS EASILY inside the case.

IC2 and IC3 be inserted in sockets. Insert and solder an 8-pin socket for IC2 and a 14-pin socket for IC3, as shown in Fig. 2. Insert and solder all other on-board leaded components in the positions shown, but do not trim any leads at this time.

Set the circuit board aside. Refer to Fig. 3, the mechanical assembly diagram, and drill the holes that you marked on the case half for mounting the ¾-inch standoffs. Then drill the holes for mounting jacks J1 and J2, precision potentiometer R3 with counter and switch S1 in the case end surfaces.

Mount the jacks, potentiometer and switch on the case half. Cut 3- to 4-inch lengths of No. 22 AWG stranded, insulated, hookup wires for making all connections to the board-mounted components, as shown in Fig. 2. Note: A lower cost counter can be substituted for the digital readout dial used in the author's prototype.

Solder one end of the wires from the jacks, potentiometer and switch and the other ends to the assigned terminal pads on the circuit board, leaving enough slack in the hookup wires to permit inverting the board and fastening it to the case half.

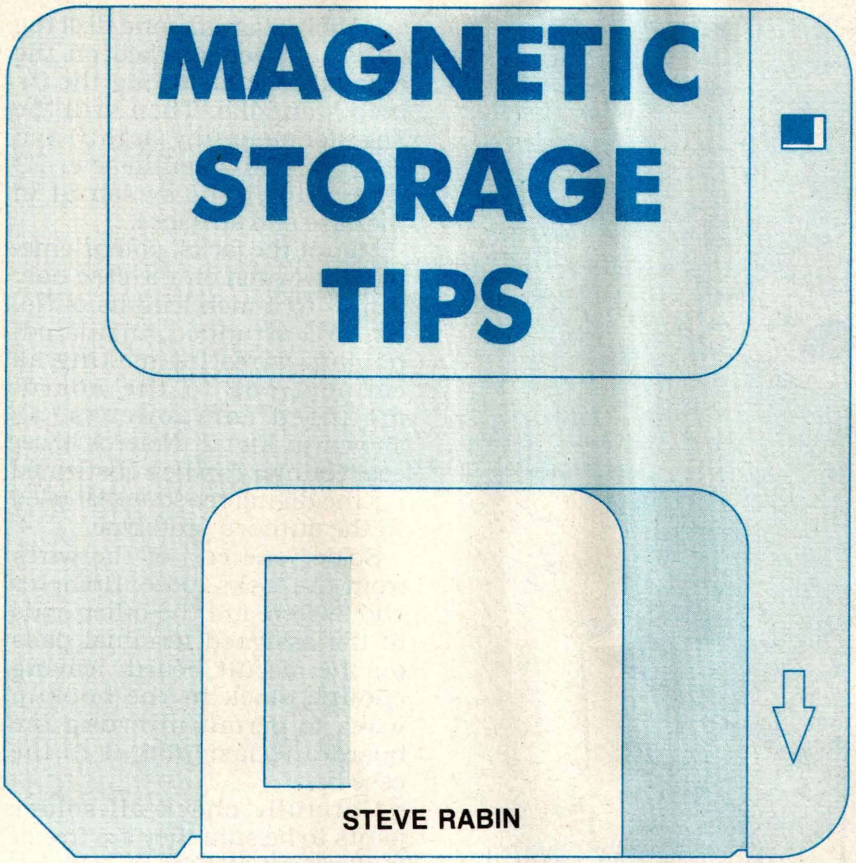
Carefully check all solder joints to be sure they are free of inadvertent bridges or cold soldering. Check IC1 to be sure that the three pins are identified and soldered correctly. Insert IC2 and IC3 in their sockets, observing the correct pin locations. After the Voltage Cursor Adapter is completely assembled it is ready for testing.

Connect the times 10 probe from the channel B input of your oscilloscope to the output jack of the Voltage Cursor Adapter.

Measuring waveform voltage

Display the signal whose voltage you want to measure by plugging a lead from the signal source into the channel A vertical amplifier jack of your oscilloscope. Set the triggering on channel A. The output is variable from 0 to 10 volts.

Set your oscilloscope's attenuators to accommodate the 0 to 10-volt range. Using the CHOPPED/ALTERNATE mode, position in the zero cursor with the channel B vertical position control. Then adjust potentiometer R3 to position the *reference voltage cursor* at the correct level on the signal waveform you want to measure. Ω



MAGNETIC STORAGE TIPS

STEVE RABIN

You can tame magnetic storage gremlins with these helpful hints.

MAGNETIC-TAPE AND FLOPPY-DISkette storage are based on reliable technologies that have been proven over many years for storing analog audio and video as well as digital computer data. However there are a few actions that you can take to improve the quality, lifetime, and interchangeability of your magnetic recordings.

Bulk-erase your media. When a magnetic head overwrites new data on previously recorded media, it will write precisely at the same track location or recording depth. Therefore a portion of the previously recorded signal will remain on the media as a noise signal.

Bulk erasing is the best way to completely erase most magnetic media. Handheld bulk erasers are low-cost, widely available devices that can improve the quality of your recordings. Unlike an overwriting magnetic head, a bulk eraser can erase the media at all recording depths, without regard to track alignment.

Limit interchange. The best quality is obtained when formatting, recording, appending and retrieval all take place on the same unit.

Every tape or disk drive will have slight variations in track locations, head-azimuth adjustments, media speed and other critical tolerances. Although each variation may be within specification, the combination of variations can cause immediate problems or reduce the storage life of the data.

Pre-formatted media adds an additional stage of interchange (because, by definition, they are recorded on a different machine). That can be compensated for by reformatting the media in the same recording unit that will be used to read, write and append data.

Select high quality media. Magnetic media contains lubricants to reduce friction, and abrasives to prevent head clog. Too much lubricant can clog the magnetic head or gum up moving parts. Too much abrasive will wear out a head prematurely. It is essential to follow manufacturer's media recommendations to avoid "sand papering" your magnetic head.

Brand new tapes are much more abrasive than tapes that have been 'burnished' by several passes across a recording head. Using a drive primarily to record brand new media will reduce its magnetic-head life below the nominal specification.

Control media storage environment. Media storage should be at the media vendor's environmental specification. Long-term storage, especially at high temperature, can result in the spreading apart of magnetic transitions, or print-through, a condition where data is unintentionally transferred between adjacent layers of tape packed on a spool.

Annual retension passes on tapes in long term storage will help prevent print through. Multiple passes across a recording head can correct a print through condition by scraping away the surface layers of the tape. Do not store media near magnetized screwdrivers, magnets, motors, audio speakers, power supplies or other equipment producing strong magnetic fields.

Retension tapes. Tape media should be occasionally retensioned by performing one complete end to end pass to prevent loose or uneven packing of tape around the cartridge hub. This should be done after each insertion into the drive, after prolonged operation over a limited area of tape, after each hour of start-stop or shuffle operations, and after exposure to a temperature change.

Tape cartridges that develop loose packs in storage should be tightened manually, if possible, before the cartridge is inserted into a drive.

Maintain equipment properly. Do not place a magnet or

Continued on page 92

The ProCar Security System

This is the third part of a series of articles about building ProCar, an automobile alarm, anti-theft, and anti-carjacking system.

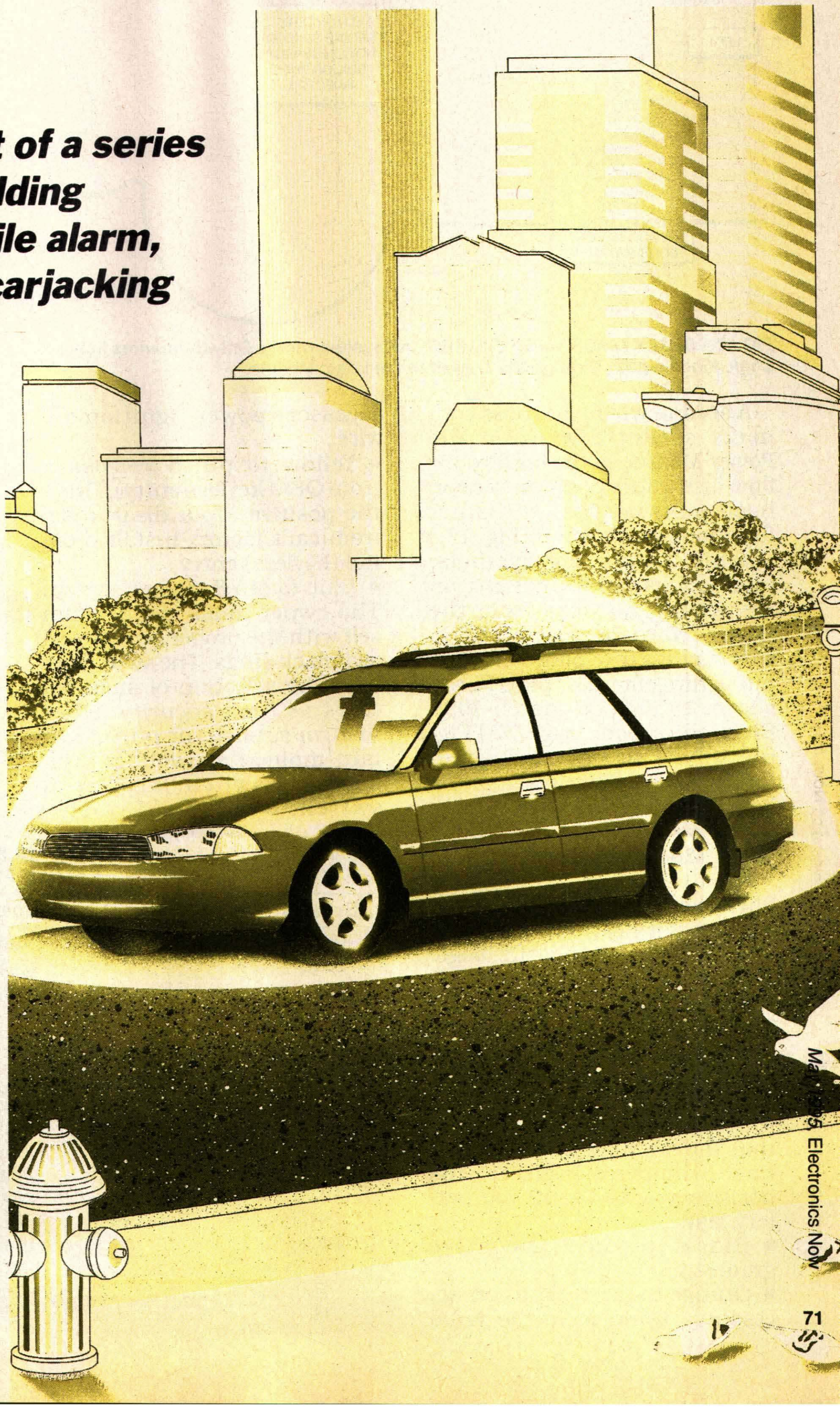
DAVID T. MIGA

THE SECOND PART OF THIS ARTICLE (*Electronics Now*, March 1995, page 65) picked up on the discussion of ProCar's Power Module and went on to describe the assembly of the Main Alarm, Voice/Options, and Power Module circuits. The Logic Module consists of the Main Alarm and Voice/Options circuits.

The wiring of the Power Module board and its assembly to the aluminum case and inter-board wiring were discussed. In addition, the formation of the wiring harnesses and the packaging of the Logic Module were explained.

Wiring harness assembly

ProCar has two wiring harnesses: A main 15-wire harness connects plug PL1 from the Logic Module to the battery, radio, door lock motor, stereo amplifier, siren, door switches, and other functions, as shown in Fig. 17. A three-wire cable from the logic module is terminated by indicator LED1, the system's only visual indicator. Four wires from the logic module connect to the optional remote radio-frequency receiver, and an antenna wire extends from the radio-frequency module.



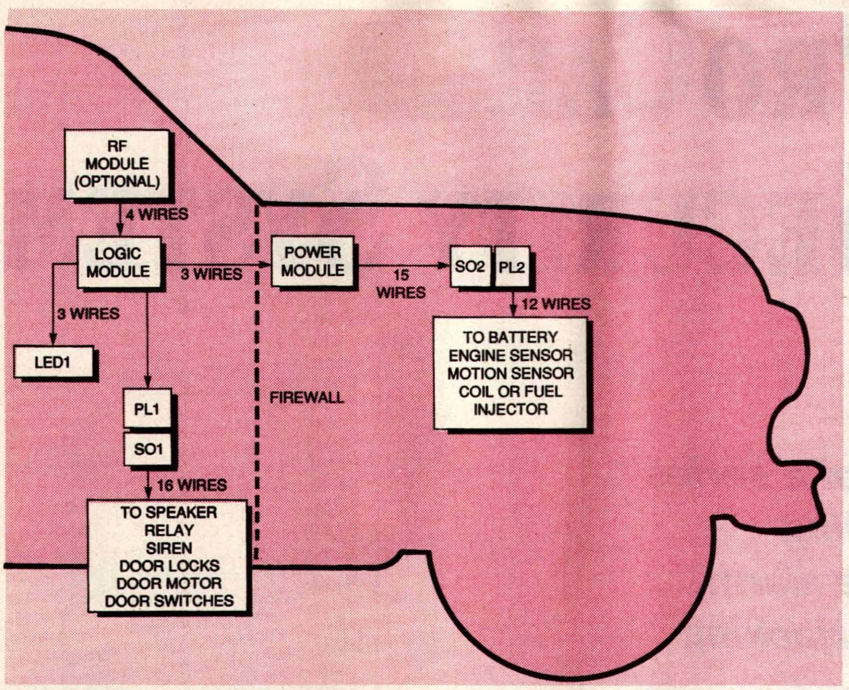

RF MODULE (OPTIONAL)
4 WIRES
LOGIC MODULE
3 WIRES
POWER MODULE
15 WIRES
SO2
PL2
12 WIRES
TO BATTERY ENGINE SENSOR MOTION SENSOR COIL OR FUEL INJECTOR
3 WIRES
LED1
PL1
SO1
FIREWALL
16 WIRES
TO SPEAKER RELAY SIREN DOOR LOCKS DOOR MOTOR DOOR SWITCHES

FIG. 17—BLOCK DIAGRAM OF THE PROCAR system wiring. Only three wires from the Logic Module pass through the firewall to the Logic Module.

A second wiring harness connects socket SO2 from the Power Module to the battery, air flow or throttle position sensor, hood pin switches, and other functions as shown in Fig. 17.

Table 2 lists the symbols, pins, colors, and functions on the wiring harness from the Logic Module socket SO1, which plugs into plug PL1. (The pin arrangement of plug PL1 is shown in Fig. 14, March 1995 *Electronics Now*, page 77.) Figure 18 is a schematic diagram for the external wiring from the Logic Module.

Logic Module connections

Refer to Table 2, Logic Module Pin Functions and Fig. 17 showing the wiring from the Logic Module. (Also see Fig. 13. Logic Module Wiring Harness, March 1995 *Electronics Now*, page 74) The following comments are specific to colored wire connections to the pins from socket SO1:

- Red to pin 1 (+12 V): Verify that the supply can produce at least 10 amperes. (Connect this positive wire to the 12-volt battery last.
- Black to pin 2 (Negative ground)
- Orange to pin 3 (Ignition accessory): Connect to the radio accessory power "ignition on" wire.
- Yellow to pin 5 (+Disarm from OEM keyless entry):This is the positive input disarm wire from car's factory-installed digital (keyless) entry.
- Blue to pin 6 (Secret switch): The owner must identify himself with the proper sequence of switch closings. The switch permits the selection of such features as *high security, valet, disarm/service*, or *panic*. Obtain momentary voltage from door-lock switch, window-up switch, windshield washer lever, or "high-beam" light switch.
- Red to pin 7 (Speaker relay positive); green to pin 8 (Speaker negative), and white to pin 9 (speaker, positive): The three wires of this cable connect to the speaker relay for switching the left front speaker from the stereo system to the voice module. (A fourth wire enters from pin 2.) **Caution**: *the speaker wires must float electrically. Relay negative connects to ground.*

Two wires connect the car's stereo amplifier to the relay: a yellow positive amplifier and a blue negative amplifier output.

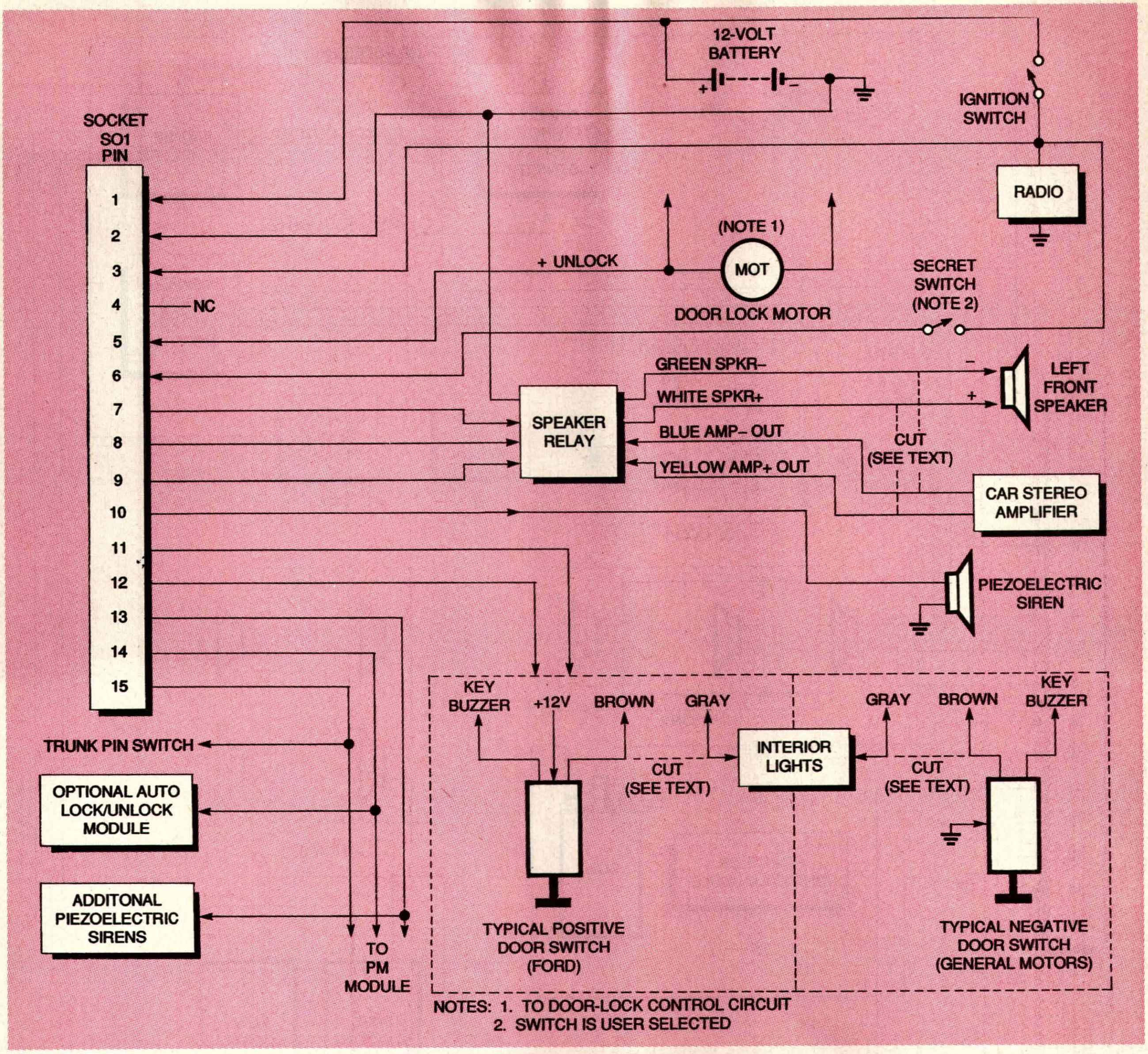
Two wires connect the car's front left speaker to the relay: a green negative speaker and a white positive speaker.

If you do not want to include the car's speaker system, install a dedicated speaker wired to green negative and white positive wires.

- White to pin 10 (Internal siren): This is a positive wire to the piezoelectric siren. Ground the siren's negative lead.
- Brown to pin 11 (Driver door): Open the Logic Module and select the positive or negative door switches at their headers. (see the specific directions for doing this further on in this article).
- Gray to pin 12 (Passenger Doors): This wire is accessible in the driver's side door. Select positive or negative door switching. (See specific directions further on in this article).

TABLE 2
LOGIC MODULE PIN FUNCTIONS

Symbol	Pin	Color	Function
+12	1	red	+12V
GND	2	black	GROUND
A	3	orange	Ignition accessory
—	4	—	Open
D	5	yellow	+Disarm from OEM keyless entry
S	6	blue	Secret switch
R+	7	red	Speaker relay +
SP	8	green	Speaker –
SP	9	white	Speaker +
I	10	white	Internal siren
DRI	11	brown	Driver door
PAS	12	gray	Passenger doors
T	13	red	Trigger
R	14	green	Armed
H	15	black	Hood/sensor


12-VOLT BATTERY
+
−
IGNITION SWITCH
SOCKET SO1 PIN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
NC
RADIO
+ UNLOCK
(NOTE 1)
MOT
DOOR LOCK MOTOR
SECRET SWITCH (NOTE 2)
GREEN SPKR−
WHITE SPKR+
−
+
LEFT FRONT SPEAKER
SPEAKER RELAY
BLUE AMP− OUT
YELLOW AMP+ OUT
CUT (SEE TEXT)
CAR STEREO AMPLIFIER
PIEZOELECTRIC SIREN
KEY BUZZER
+12V
BROWN
GRAY
INTERIOR LIGHTS
CUT (SEE TEXT)
GRAY
BROWN
KEY BUZZER
CUT (SEE TEXT)
TRUNK PIN SWITCH
OPTIONAL AUTO LOCK/UNLOCK MODULE
ADDITONAL PIEZOELECTRIC SIRENS
TO PM MODULE
TYPICAL POSITIVE DOOR SWITCH (FORD)
TYPICAL NEGATIVE DOOR SWITCH (GENERAL MOTORS)

NOTES: 1. TO DOOR-LOCK CONTROL CIRCUIT
2. SWITCH IS USER SELECTED

FIG. 18—WIRING FROM THE LOGIC MODULE via socket SO1 to the speaker relay, siren, door locks, motors, and switches and other under dashboard functions.

- Red to pin 13 (Trigger), green to pin 14 (Armed) and black to pin 15 (Hood sensor): Pass the cable containing these three wires through the car's firewall to the Power Module. The connections of these wires are:
- Red, positive output to Power Module for external siren power. (This wire can power other sirens or relays if their current drain is less than 1 ampere.)
- Green: becomes positive when the system is armed to cut out the engine. This wire also signals the optional automatic door-locking and unlocking relays.
- Black: hood switch and motion sensor from the Power Module. Connect special sensors, such as microwave field sensors to this wire. (standard grounded switching.) There is no limit to the number of switches that can be connected to this wire.

Cut appropriate six-foot lengths of red and black No. 16 AWG stranded, insulated, hookup wire. The red wire will connect from pin 1 of the socket SO1 to the battery and ignition switch, and the black wire will connect pin 2 of SO1 to the negative side of the battery and ground.

Cut approximately six-foot lengths of the appropriately colored No. 18 AWG stranded, insulated hookup wire for pin 3 (to ignition accessory); pin 5 (+Disarm) to the door-lock motor; pin 6 (to secret switch); pin 10 (to the internal piezoelectric siren); pin 11 (to driver's side door switch); and pin 12 (to the passenger door switches). Crimp the ends of the wires to AMP A1441 socket sleeves and insert them in the 15-pin socket SO1 (AMP A14630).

Cut a 10-foot length of three-conductor cable that will pass through the car's firewall to the Power Module to be located in the engine compartment. Crimp and connect the wires to SO1 socket pins 13 through 15. The wire from pin 13 also goes to additional

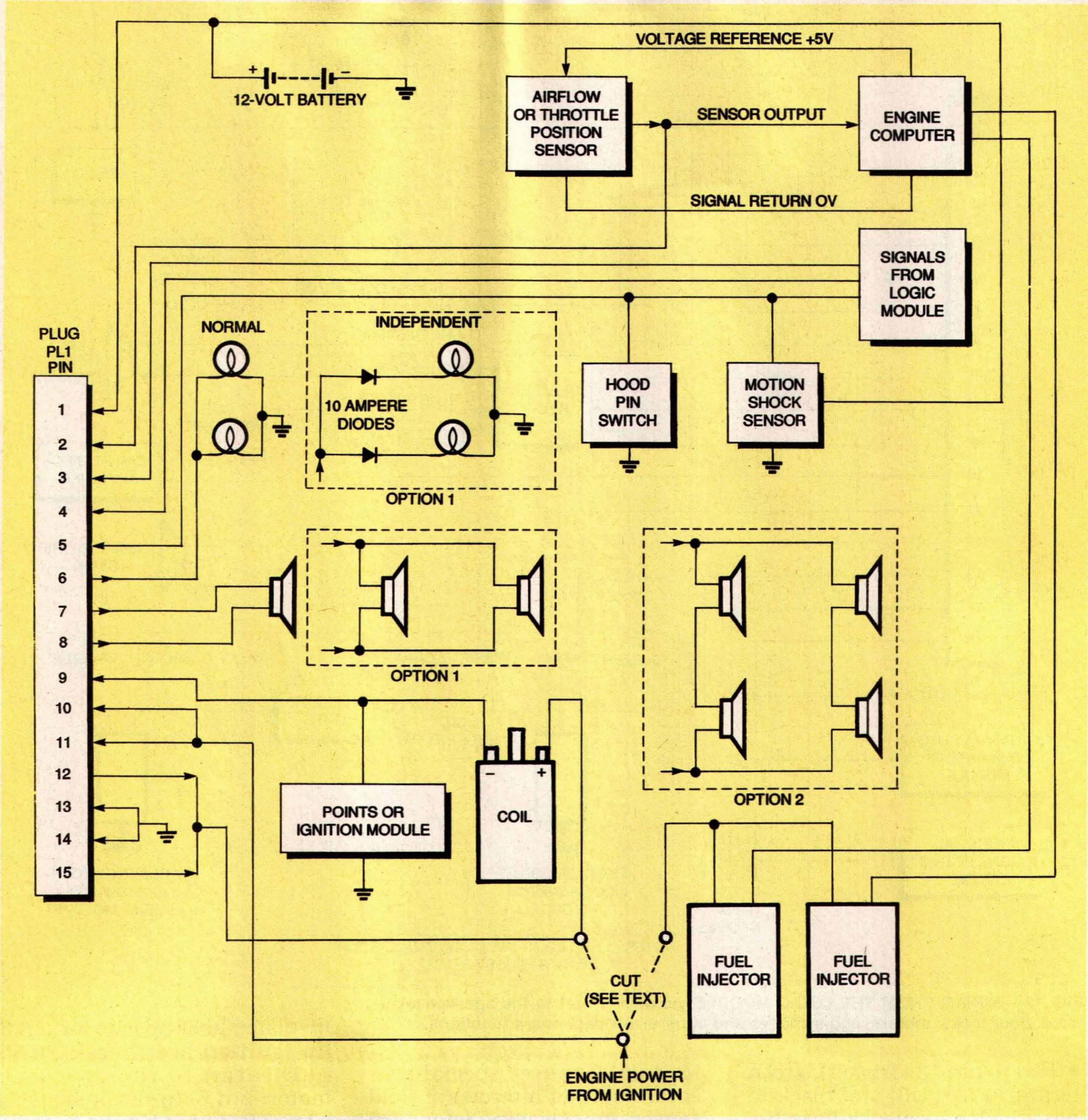

VOLTAGE REFERENCE +5V
+
−
12-VOLT BATTERY
AIRFLOW OR THROTTLE POSITION SENSOR
SENSOR OUTPUT
ENGINE COMPUTER
SIGNAL RETURN OV
SIGNALS FROM LOGIC MODULE
PLUG PL1 PIN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
NORMAL
INDEPENDENT
10 AMPERE DIODES
OPTION 1
HOOD PIN SWITCH
MOTION SHOCK SENSOR
OPTION 1
OPTION 2
POINTS OR IGNITION MODULE
COIL
−
+
FUEL INJECTOR
FUEL INJECTOR
CUT (SEE TEXT)
ENGINE POWER FROM IGNITION

FIG. 19—WIRING FROM THE POWER MODULE via plug PL2 to the battery, engine sensor, motion sensor, coil or fuel injector sensors and other engine compartment functions

piezoelectric sirens; the wire from pin 14 also goes to the optional auto lock/unlock module and the wire to pin 15 also goes to the hood pin switch.

Wire the speaker relay RY1 to an approximate 1-foot length of four-wire shielded cable containing black, red, green, and white wires as follows: pin 2, black, ground; pin 7, red, speaker relay +; pin 8, green, speaker −; pin 9, white, speaker +.

Wire a four-wire shielded cable from the speaker relay to the car's left front speaker and stereo amplifier. Connect the green wire to the speaker −; white wire to the speaker +; blue wire to the amplifier − output; and yellow wire to the amplifier + output. Enclose the relay in a rubber or shrinkable-plastic tube to keep out moisture and dust from the exposed pins as well as to avoid unintentional short circuits.

Installation

Mount the Logic Module high up under the car's dashboard behind the center console with appropriate fasteners.

When you wire the Logic Module harness to its intended speakers, switches and other destinations, the red battery power wire (pin 1, +12V) must be the last one connected because ProCar will auto-arm when a positive voltage is on the red wire.

Mount the three-color LED on the end of the cable through any flat surface on the automobile's dashboard that is less than 3/16-inch thick. Drill a 3/16-inch hole, then carefully ream it so that the reflector of LED1 fits securely in position.

Power Module wiring

The Power Module contains the circuits for flashing lights, sounding the siren, powering the fuel-injection system and performing other functions. It has a 15 pin socket SO2 (See Fig. 19 and Table 3 and Fig. 10 (March 1995 *Electronics Now*). Select the wire sizes following the guidelines given for the Logic Module harness. The wires to the mating plug are as follows:

- Red to pin 1 (+12V): Battery positive for light flasher power. It must be able to supply up to 15 amperes.
- Brown to pin 2 (Engine sensor defeat–ESD): This defeat wire intermittently grounds the output from the airflow sensors (AFS) or throttle-position sensors (TPS) through a protective resistor. It simulates engine problems to a carjacker.
- Red to pin 3 (Trigger), green to pin 4 (Armed) and black to pin 5 (Hood/shakes): the three wires form a cable. Connect the black wire from pin 5 to the motion sensor and the hood pin switch. There is no restriction on the number or type of motion sensors or pin switches that can be connected to that black wire.
- White pin 6 (Light/flasher) is a positive output wire to the parking lights. Its maximum load of 15 amperes is protected by a 10-ampere automatic-reset circuit breaker CB1.
- Silver to pin 7 (Speaker) and gold to pin 8 (Speaker): This pair of wires can connect up to four four-ohm horn speakers to the siren module. Both wires should "float" electrically
- Green to pin 9 (Coil negative): This wire intermittently short-circuits the points or ignition module and negative side of the coil to ground when the siren is activated.
- Orange to pin 10 (Engine power, input 1) and orange to pin 11 (Engine power, input 2). Connect both orange wires. (The second wire is a backup wire.) The paired wires are connected to the wire that normally provides power to the fuel injectors or ignition coil.
- Yellow to pin 12 (Engine power, output 1) and yellow pin 14 (Engine power, output 2). The Power Module routes (or interrupts) the power input on pins 10 and 11 to pins 12 and 15. The output of pins 12 and 15 is fed to *either* the fuel injectors or the positive side of the coil. The paired yellow and orange wires will supply up to 20 amperes.

Note: The connection at the junction between the pairs of orange and yellow wires is broken as soon as ProCar is armed. This does not occur for the green (Coil negative) or brown (Engine sensor defeat) wires which are only activated simultaneously with the siren.

- Black to pin 13 (Ground) and black to pin 14 (ground): Ground both of these wires.

Power Module installation

The Power Module contains circuitry for flashing the lights, powering the external siren speakers, the fuel system, ignition shutoff, and engine shutdown circuits. Mount the module in the engine compartment high enough up to be in a dry location and away from the exhaust manifold so that air can circulate freely around it.

Light flasher

After mounting the power module, connect the wire from the vehicle's parking light on the same side of the vehicle as the power module. (Identify this parking light power wire by turning on the parking lights and finding the live wire.) **Caution**: *Do not use the headlight wires.*

Connect the power wire to the white wire from pin 6 (Light/flasher) of the power module. If ProCar lights the driver's side parking lamps when activated, install 10-ampere diodes to isolate the driver's side and passenger light circuits, as shown in Fig. 19.

Ignition cutoff

The green wire from pin 9 (Coil negative) of the Power Module will intermittently short circuit the negative side of the ignition coil to ground through an internal ballast resistor only when the siren is activated. This will simulate intermittent engine trouble. The wire was intended for typical, single-coil ignition systems, but it can be wired to one of the coils of a multicoil system.

Caution: If the green pin 9 wire is used, *do not* connect the brown engine sensor defeat (ESD) wire from pin 2.

TABLE 3—POWER MODULE PIN FUNCTIONS

Symbol	Pin	Color	Function
+	1	red	+12V
E	2	brown	Engine sensor defeat (ESD)
T	3*	red	Trigger
R	4*	green	Armed
H	5*	black	Hood/speaker
L	6	white	Light/flasher
S	7*	silver	Speaker
S	8*	gold	Speaker
P	9	green	Coil negative
I	10*	orange	Engine power (Input 1)
I	11*	orange	Engine power (Input 2)
C	12*	yellow	Engine power (Output 1)
G	13*	black	Ground
G	14*	black	Ground
C	15*	yellow	Engine Power (Output 2)

*Denotes functional pairs or cable

Locate the coil if the car has a coil and a distributor. Expect to see two or more small wires leading to the coil. Ignore the high-voltage distributor wire. Start the car and measure the voltage at the terminations of the small wires.

The voltage on one wire will be +12 volts. The second wire (or wires) are switching wires to the ignition amplifier module (or the points on older model cars). A voltage lower than +12 volts that varies with engine revolution per minute should appear on those wires.

If you make the measurement with an oscilloscope, expect to see a voltage squarewave as the coil discharges. If this is seen, the correct wire to join to the green wire from pin 9 of the Power Module has been correctly identified.

Disabling sensors

Some late model cars do not have an ignition coil system. The brown (Engine sensor defeat–ESD) wire from pin 2 of the Power Module can be wired to many different kinds of sensors on a fuel-injected engine to cause the engine to sputter and stall without damaging it. Two examples are the airflow sensor (AFS) or throttle-position sensor (TPS).

The output voltages of those sensors vary with engine acceleration. Each sensor has two or three wires. The voltage on one wire will vary directly with engine revolutions per minute. Connect that wire to the brown engine sensor defeat (ESD wire, pin 2 from the Power Module.

Caution: The car's engine electronics will not be damaged if *only* the wire carrying the changing voltage is connected to the brown ESD) wire. If the brown wire is connected, *do not* connect the green (Coil negative) wire from pin 9.

Power cutoff circuit

If the engines of cars with automatic transmissions are shut off, the power steering and braking functions will be disabled. Therefore, the orange engine power input 1 wire from pin 10 and the yellow engine power input 2 wire from pin 11 should not be connected to shut off the fuel system. Instead, the green coil negative wire from pin 9 or the brown ESD wires will ground pulsed signals. Those signals stall the car intermittently and slow it down, rendering it virtually undrivable. However, the pulse signals will not cause the driver to lose control of the car.

The direct link between the engine and transmission on cars with standard transmissions will allow the engine crankshaft to turn as the car decelerates. Although the ignition is shut off, the car's brakes and steering function will remain unaffected.

Power cutoff to fuel

Cars with fuel-injection have an electric fuel pump, fuel injectors, and a fuel-control relay. The two orange engine power input 1 and 2 wires from pins 10 and 11 and the two yellow engine power output 1 and 2 wires from pins 12 and 15 of the Power Module can be connected to act as a normally closed switch. The "switch" opens when Logic Module directs the Power Module to shut down the engine.

ProCar includes two identical switches, wired in parallel for failsafe operation. Be sure to install both pairs of orange and yellow wires.

The best way to cut off fuel is to wire ProCar to the fuel relay if you car has one. The fuel relay is usually in the engine compartment and it draws low current. As another person turns the ignition key on and off, listen in the engine compartment for the sound of the fuel relay contacts clicking.

Find the wire to the fuel relay coil and cut it. Wire the orange engine power input wires from pins 10 and 11 of the Power Module to the power source and the yellow wires from pins 12 and 15 to the relay coil. **Warning**: *It is important that the orange wires receive the voltage and the yellow wires deliver the power to the load. The circuit MOSFETS are unidirectional, so if the wires are reversed, the power module will be damaged.*

The second alternative is to cut power to the fuel injectors. The injectors are wired together with the wire bundle terminating at a multipin connector. Measure the voltage at each wire as the engine is running. Only one wire will carry a constant 12 volts. The voltage on the others will be lower.

Accelerate the engine to obtain a better reading. The injector wire voltage drops as engine revolutions per minute are increased. An oscilloscope screen will show a narrow negative pulse imposed on the 12-volt level at the injector wires. Wire a connection into the constant power wire that supplies all of the injectors.

Cut the constant 12-volt wire to all injectors. Connect the 12-volt wire to the two orange (engine power input 1 and 2) wires from pins 10 and 11 of the Power Module. Connect the other end of the cut wire (to the injectors) to the two yellow engine power output 1 and 2 wires from pins 12 and 15 of the Power Module. **Caution**: *Reversing these wires will damage the Power Module.*

Another alternative is to use the fuel power cutoff circuit as a starter interrupter. A thief or carjacker might panic if the engine shuts down completely within seconds after an attempted carjacking, especially if the vehicle has an automatic transmission.

To delay engine shutdown, cut the small start wire from the ignition key to the starter solenoid and wire the power source to the orange engine power input wires, and the solenoid wire to the yellow engine power output wires.

Mechanical fuel systems

On cars that do not have fuel injectors, the power cutoff circuit can cut power to the ignition coil. Follow the instructions for wiring the ignition cutout circuit given earlier. The ignition input to both the coil and the points or ignition module is 12 volts.

If the green coil negative wire from pin 9 to the points or ignition module has been connected, cut the 12-volt ignition power to the coil positive and wire the orange engine power input wires to the power source, and the yellow engine power output wires to the coil power input.

The power cutoff circuit can also disable the starter in those cars instead of removing ignition power. Alternatively, an electric fuel cutoff solenoid (a standard part available at most automotive supply stores) can be installed.

Caution: *If the power cutoff circuit is installed to cutoff power to the fuel or ignition system, the engine will be shut down completely 10 seconds after the voice warning.*

Motion sensor

Mount the motion sensor on a vertical metal surface within the engine compartment (*avoid plastic surfaces*) on the driver's side as close to the firewall as possible so that sound vibrations will be conducted effectively. Connect the black hood shaker wire from pin 5 of the Power Module to the motion shock sensor.

Connect the red +12V power wire from pin 1 of the Power Module to the motion sensor and ground the two black wires from pins 13 and 14 of the Power Module.

When adjusting the motion sensor, temporarily disconnect any plunger or pin switches. Adjust the motion/shock sensor so that it requires at least a heavy impact through a distance of about one foot directed at either the front or rear bumpers to respond.

Pin/plunger switches

There is no limit to the number of grounded pin or plunger switches that can be connected to the black hood/shaker wire from pin 5 of the Power Module.

The ProCar circuit will operate reliably even if any of the pin/plunger switches connected to the black wire are filled with water or have mildly corroded contacts. The resistance across a pin switch should be zero ohms when actuated and have an infinite value when open. The ProCar circuit considers any resistance value less than 400 ohms to be equivalent to zero ohms and any value more than 400 ohms to be infinite.

The voltage reading should be 11 volts when all entry points are closed (The system need not be armed to make this measurement.) If the voltage measurement is lower than 10 volts, examine all pin switch or the motion/shock sensor for defects. If both sirens are activated immediately after the system arms itself, the fault is probably a defective or intermittent pin switch or sensor.

Any "stuck" sensor that causes the voltage to drop to zero will prevent the system from arming itself, and status indicator LED1 will stay green. Install only pin/plunger switches with plastic rather than steel bodies to eliminate false alarms due to moisture condensing on the switch contacts.

Keyless-entry system

The logic module can be wired into any vehicle with a digital (keyless) entry system that provides a positive pulse from the door lock solenoid. Refer to Table 2 and Fig. 17. The yellow wire from pin 5 (+Disarm from OEM keyless entry) will disarm ProCar with a positive pulse. To integrate ProCar into a vehicle's factory-installed remote control or keyless-entry system, tap into the wire on the car's door-lock motor that becomes positive when opened.

If the high security level is selected, the keyless entry will only unlock the doors. The ProCar system will let the driver in, but the alarm will sound if the system does not receive the secret signal within 15 seconds.

Four-function remote

If you plan to install the optional remote radio-frequency receiver, mount it high enough

TABLE 4
LOCK-CONTROL
WIRE IDENTIFICATION

Color	Function
Red	+12 V Battery
Black	Negative ground
Orange	Positive switch lock
Yellow	Negative switch lock
Green	Driver door motor +Unlock
Blue	Driver door motor +Lock
White	Driver OEM wire +Unlock
Brown	Driver OEM wire +Lock
Gray	Ford lock switch

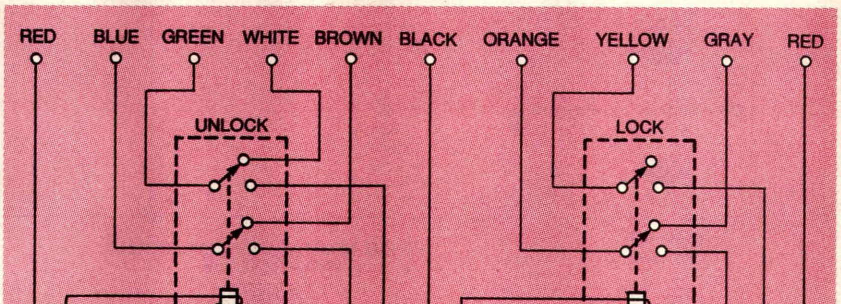


FIG. 20—WIRING FOR AUTOMOBILE DOOR LOCKS.

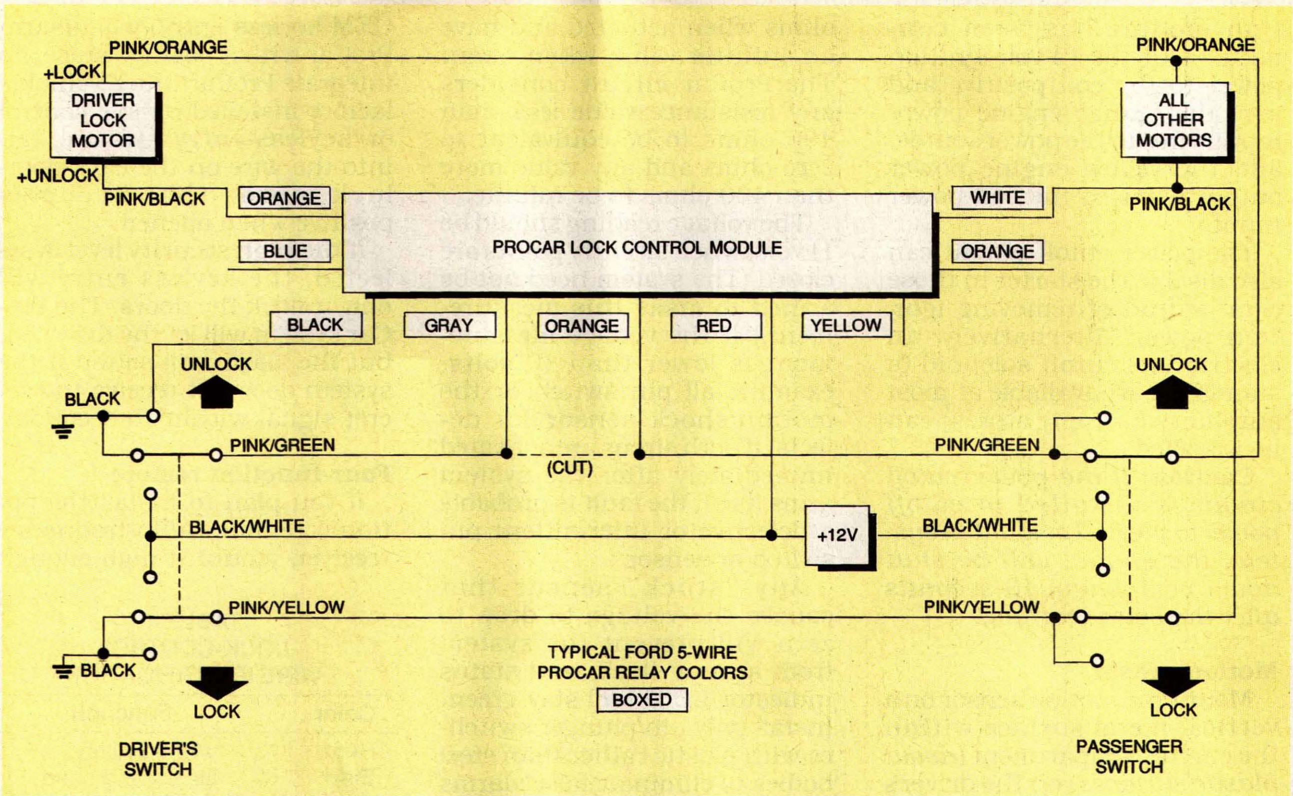

PINK/ORANGE
+LOCK
DRIVER LOCK MOTOR
+UNLOCK
PINK/BLACK
ORANGE
BLUE
PROCAR LOCK CONTROL MODULE
WHITE
ORANGE
PINK/ORANGE
ALL OTHER MOTORS
PINK/BLACK
BLACK
GRAY
ORANGE
RED
YELLOW
UNLOCK
BLACK
PINK/GREEN
(CUT)
BLACK/WHITE
+12V
PINK/YELLOW
BLACK
LOCK
DRIVER'S SWITCH
TYPICAL FORD 5-WIRE PROCAR RELAY COLORS
BOXED
UNLOCK
PINK/GREEN
BLACK/WHITE
PINK/YELLOW
LOCK
PASSENGER SWITCH

FIG. 21—TYPICAL DOOR LOCK INSTALLATION WIRING for positive switching in Ford cars.

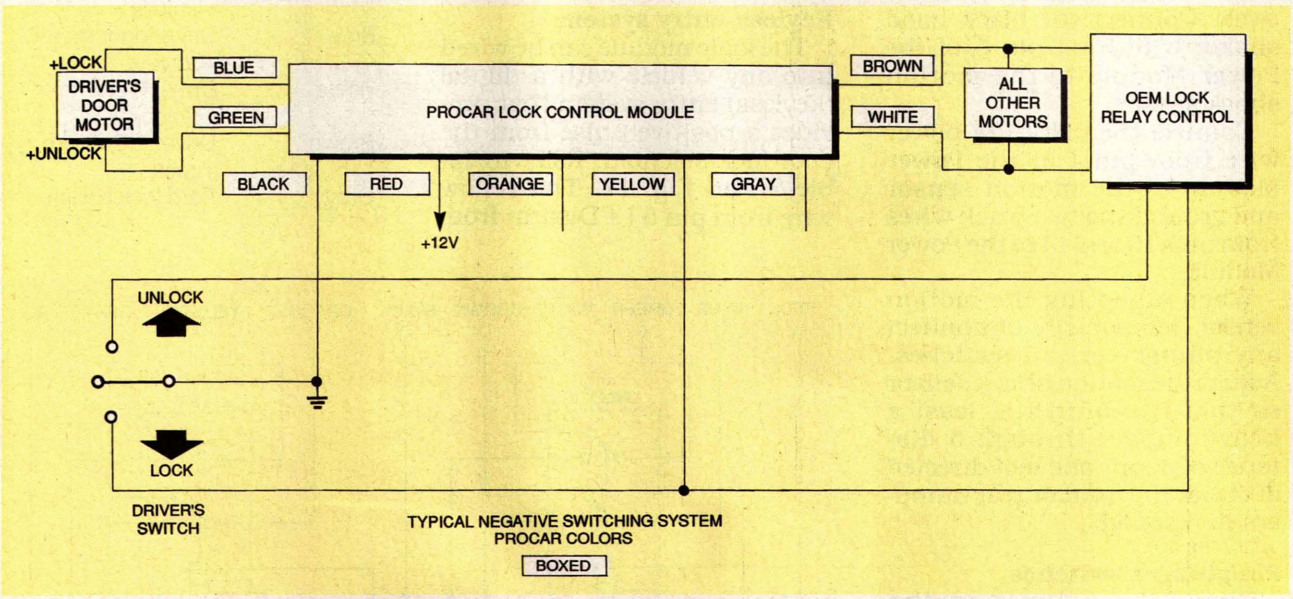

+LOCK
DRIVER'S DOOR MOTOR
+UNLOCK
BLUE
GREEN
PROCAR LOCK CONTROL MODULE
BROWN
WHITE
ALL OTHER MOTORS
OEM LOCK RELAY CONTROL
BLACK
RED
ORANGE
YELLOW
GRAY
+12V
UNLOCK
LOCK
DRIVER'S SWITCH
TYPICAL NEGATIVE SWITCHING SYSTEM PROCAR COLORS
BOXED

FIG. 22—TYPICAL DOOR LOCK INSTALLATION WIRING for negative switching in foreign cars.

under the dashboard so that its antenna wire can be fastened close to the windshield. Terminate the four wires from the Logic Module (see Fig. 13, page 74 March 1995 *Electronics Now* with the flat plug provided. Plug in the receiver *after* the red power wire has been connected. If power is applied after the system is wired, ProCar will arm and the remote receiver could then enter the panic mode immediately.

Identify the antenna wire from the module and attach its end as high as possible under the dashboard with a sheet metal screw. The range of the antenna depends on the height of the radio-frequency receiver and antenna under the dashboard.

If the vehicle is started as soon as the red wire is attached, ProCar will auto-arm, and the remote receiver could enter the panic mode immediately. If the sirens and light flasher are activated immediately after the red wire to the logic module is hooked up, push the No. 1 panic button on the remote control, then

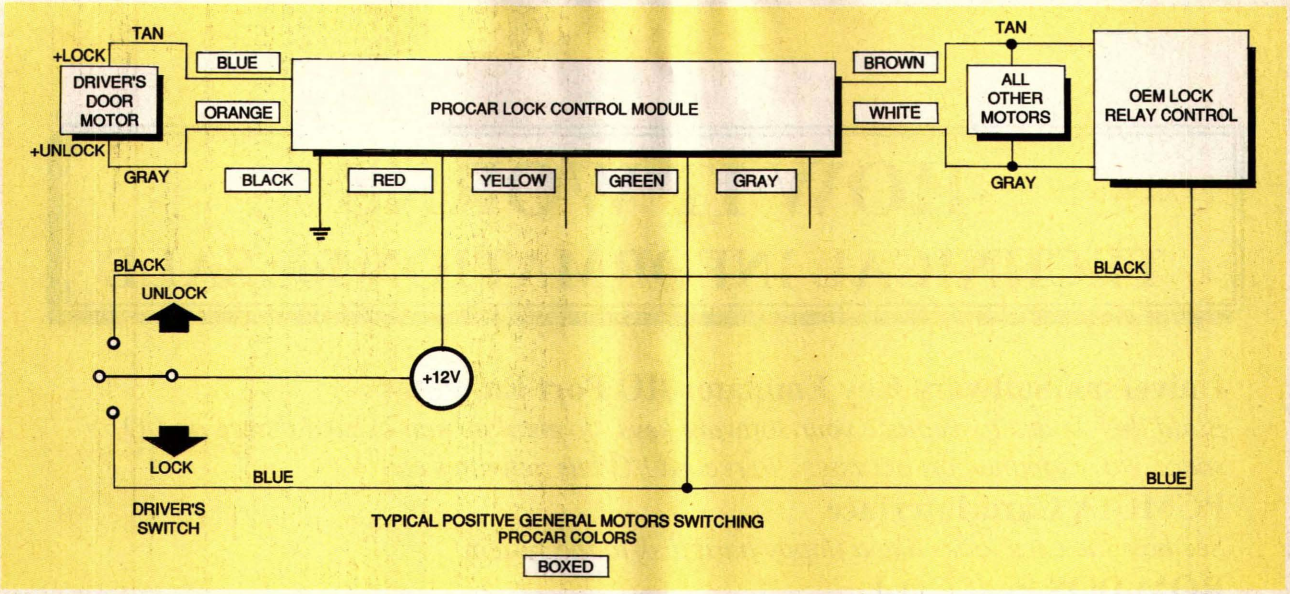


FIG. 23—TYPICAL DOOR LOCK INSTALLATION WIRING for positive switching in General Motors cars.

disarm the system by holding the No. 2 button for 3 seconds.

Automatic door locking/unlocking

Refer to Table 2 and Fig. 18. This feature allows the original power door locks to be syncronized with ProCar. Connect the optional auto lock/unlock module to the green Armed wire from pin 14 of the Logic Module. This circuit will lock all door locks as ProCar arms, and the unlocking relay will unlock the driver's side door only when ProCar disarms.

The locking feature will lock the keys inside the car if they are left in the ignition switch and all car doors are closed. However, ProCar allows a delay and sounds an audible warning before it arms and locks. If the driver has the remote control, he or she can unlock the driver's side door while simultaneously disarming ProCar.

If you want ProCar to lock the doors automatically after you leave the vehicle, or if you want to use the remote control and want ProCar to unlock the driver's side door as you disarm the system, wire the circuit shown in Fig. 20, the door lock control schematic. The lock and unlock circuits are shown separately. Table 4 identifies the functions of the colored wires in Fig. 20. Solder the components directly to the relay terminals.

The door-lock control is designed to be universal for any vehicle, whether positive-switching, ground-switching, or five-wire switching.

Figure 21 is a diagram of a typical Ford autmotive five-wire switching system, Fig. 22 is a diagram of a typical foreign car negative switching system; and Fig. 23 is a diagram of a typical General Motors positive switching system. The colors of the wires from the Procar system are enclosed in boxes in these figures.

Ordering Information

The following three complete circuit boards are offered:

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Door-monitoring circuits

The door switches on modern cars are set up in one of two different ways. They can either switch positive voltage to the dome lamps, or with positive on one side of the lamps, switch negative, or ground to the other side of the lamp. General Motors vehicles typically have negative switching while Ford vehicles have positive switching.

ProCar monitors the doors individually, but the system has been designed so that the installer need only gain access to the wiring of the switch in the driver's side door. ProCar circuitry will connect the car's electrical system to light interior dome lights when any door is opened. Nevertheless, it will discriminate between the different doors.

Positive switches

Locate the door-light switching wire. Verify that all of the passenger doors, hatch or trunk are closed. Open the driver's side door, and remove the

Continued on page 94

HOW IT WORKS

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DON LANCASTER

Way back in the seventh grade, I had a brilliant idea on how to "improve" VHF radio vacuum tubes by *eliminating* all of their internal interelectrode capacitances. That would be achieved by arranging the cathode and plate planar beside each other, and then placing the grid at right angles to them. I reasoned that there would be zero capacitance among the three. I vaguely remember assigning magnets to somehow bend the electron beam from cathode through the grid to the plate. I even sent this idea to RCA.

Sorry, but electrical capacitance *always* exists *everywhere*. Separate a conducting point from another with an insulator, and you've got a capacitor. Period. All that my scheme did was reduce the capacitance slightly. Obviously, I had never heard of *transit time*, *electron ballistics*, or *parasitics*. Or any of the other crucial gotchas important for any high-frequency design.

Naturally, it never dawned on me for an instant that similar ideas might have occurred to RCA's hired help. History seems to be repeating itself among my helpline callers, so we need to talk about...

"Too good to be true" results

Let's see. One caller has a zero-inductance scheme that is remarkably similar to my zero capacitance one. Of course, there are all of the usual motors and magnets perpetual-motion folks. Another caller has information traveling faster than the speed of light. One believes that a ridiculous amount of spark advance is all you need for a super efficient gas engine. Yet another claims to have developed an ultra small satellite antenna system.

I would really like to reply to all of these people "You are wrong." The outcome is not now and never was in doubt. All that remains is deciding whether you want to find out *how* or *why* you made your error. Figure 1 shows my guidelines for dealing with "too good to be true" results.

0. They are.
1. The primary cause of an outrageous result is an outrageous mistake.
2. The secondary cause of an outrageous result is not having enough tools and skills to understand the problem.
3. Outrageous results *demand* that you make heroic efforts to thoroughly *disprove* them.
4. It is trivially easy to be "not even wrong".
5. Have others ever thought about this problem? When? How?
6. Have you completed a thorough DIALOG search? Do you personally subscribe to most of the industry trade journals? Are you aggressively using online resources?
7. What do you know that "they" do not?
8. What are you bringing to the table that is genuinely new?
9. Is hubris a factor?
10. Extreme paranoid secrecy or obsessions with patent "protection" are *certain* to cost you dearly in the long run.
11. If the result *still* looks legit, reduce the effect to its most fundamental terms. Then create a simple and reproducible experiment that some disinterested outsider can verify or disprove.

FIG. 1—MY GUIDELINES FOR dealing with "too good to be true" results.

If you have *any* conductor routed between two points in space, you *do* have inductance. Period. All that a non-inductive winding does is make the inductor physically *larger* in size.

Nobody who has ever stayed awake during Physics 101 lectures would even dream of trying to achieve perpetual motion. Without exception, *each* and *every* attempt to date has failed spectacularly. There is not one shred of evidence that such a thing is even remotely possible.

On extreme spark advance: there are few dead horses that haven't been whipped as thoroughly as this one. Try the *SAE Library* for more information.

I got the impression the antenna person never even heard of "Doctor Maxwell's silver hammer," nor read chapter twelve of H. Jasik's *Antenna Engineering Handbook*. Nor has he appreciated the zillions of small antenna failures and outright scams littering all of satellite TV history.

An antenna has an *effective area*. There is a specified amount of input energy flux going into that area. You can do no better than grab it all. But even *trying* to grab it all will cause ugly *sidelobes*.

If you want a smaller antenna, raise the frequency and the transmit power. That's how the direct broadcast satellite (DBS) folks do it for their new services.

I like to encourage people to think about things and then come up with new ways of looking at problems. And, yes, new or improved antennas are certainly possible. But results that seem to be "too good" are *always* suspect.

New BASIC stamps

Lance Wally of *Parallax* just sent me a few samples of his brand new BS1-1C BASIC *Stamp Module.* This $29 module is an *entire* computer measuring 0.4 by 1.4 inches. Figure 2 shows the stamp's actual size. The schematic for the new stamp is shown in Fig. 3.

Just in case you've come in late, there's a new microcontroller on the block called a PIC chip from Microchip Technology, Inc. These are clearly *the* hacker component of the decade. They cost under one dollar in large quantities. Dozens of PIC projects already have appeared in print, and hundreds more are on the way.

Thanks to an unusual architecture and a minimal RISC instruction set, PICs blow away *all* of the earlier microcontrollers, usually with three times the performance or more. The same unusual architecture makes it possible to distribute any problem among two or more PIC chips.

The PIC chips are far easier to use than, say, a 555 timer. And lead to *far* lower cost products. If your circuit contains eight or more parts and if one of them is an active device, then you most likely should use a PIC instead.

As we saw last month, you can easily perform such PIC tricks as creating complete digital sinewave generator with only six bytes of code. But the really great thing about PICs is that they are simple and fun to use. *None* of the traditional microprocessor hassles remain.

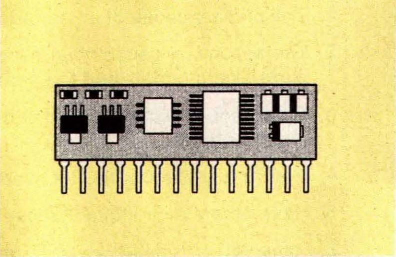

FIG. 2—NEW $29 BASIC STAMP is an incredibly versatile microcontroller. It is shown here full size.

You can easily code these by hand without ever going near an assembler or an emulator. In fact, I strongly recommend that you write at least your first 1200 lines of PIC code by hand.

For those of you that don't want to jump in with both feet, the BASIC stamps make becoming microcontroller-literate quite easy. After a few of the stamp projects, you can step up to "real" PIC projects with blazing speed.

No matter where you look in the PIC universe, amazing and elegant hacks show up. Note the apparent misprint in Fig. 3, where a logic output becomes the supply pin for another chip. This is in fact a cute power-saving trick. If you aren't immediately using a chip, disconnect it.

I'll get into these a lot more in future columns. But for now, you get started by picking up the free catalog from *Parallax*, the "must have" free *Microcontroller Handbook* and *PIC Applications Manual* from *Microchip Technology*, and the really unique *PIC Tools* and *Stamp Extenders* from *Scott Edwards Electronics*.

As our resource sidebar for this month, I've listed several more key sources for PIC information and applications support. Don't miss this one!

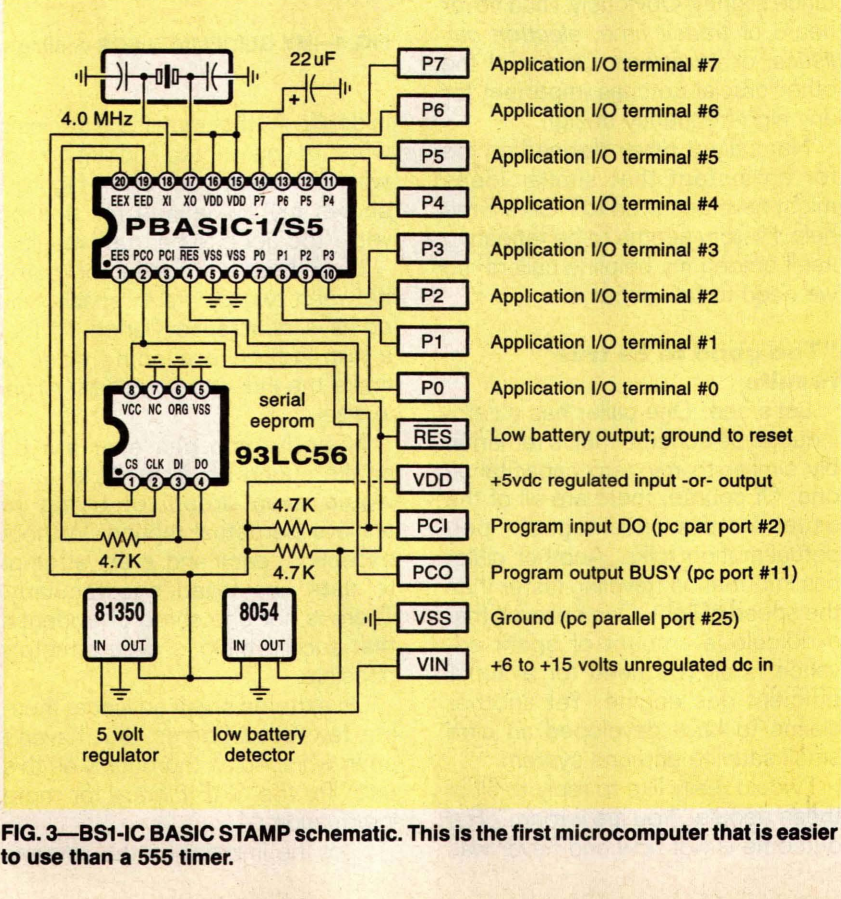
4.0 MHz
22uF
PBASIC1/S5
EEX EED XI XO VDD VDD P7 P6 P5 P4
EES PCO PCI RES VSS VSS P0 P1 P2 P3
VCC NC ORG VSS
CS CLK DI DO
serial eeprom
93LC56
4.7K
4.7K
4.7K
81350
IN OUT
8054
IN OUT
5 volt regulator
low battery detector
P7 Application I/O terminal #7
P6 Application I/O terminal #6
P5 Application I/O terminal #5
P4 Application I/O terminal #4
P3 Application I/O terminal #3
P2 Application I/O terminal #2
P1 Application I/O terminal #1
P0 Application I/O terminal #0
RES Low battery output; ground to reset
VDD +5vdc regulated input -or- output
PCI Program input DO (pc par port #2)
PCO Program output BUSY (pc port #11)
VSS Ground (pc parallel port #25)
VIN +6 to +15 volts unregulated dc in

FIG. 3—BS1-IC BASIC STAMP schematic. This is the first microcomputer that is easier to use than a 555 timer.

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AC motor drives

Induction-motor speed controls and electric auto drives are both of major hacker interest these days. In both cases, the key is to come up with a variable voltage and a variable frequency power sinewave cheaply and conveniently.

Sadly, a plain old linear amplifier will not hack it. That's because there's no known linear amplifier that offers any decent efficiency. Instead, you might want to go to one of the routes of Fig. 4. A DC power supply is connected to one winding of an AC motor through a pair of switches. The switches are often called a *bridge drive*.

The trick is to flip the switches just right so that the motor thinks it is seeing a variable voltage and variable frequency pure sinewave. What gets hairy fast is that you'll want to minimize motor *harmonics* because harmonics cause power loss, whine, cogging, and even instability. You'll also want to flip the switches as *few* times as possible per cycle because each flip costs you dearly in *transition* losses.

A classic method of dealing with power sinewaves is known as PWM, short for *pulse width modulation*. A high-frequency carrier becomes duty-cycle modulated with the sinewave. The fundamental is *not* present at first. It appears only after the PWM waveform has been *summed*, or *integrated*. Fortunately, the inductance of the motor winding forms a low-pass filter that doubles as an integrator, thus converting the duty cycle variations into a fundamental sinewave. There will be no low harmonics if the carrier frequency is high enough.

But PWM does have some nasty habits. Nonlinearities, quantization, and DC offset in the modulation shows up as output distortion. And the high-frequency carrier amplitude is *always* larger than the fundamental—gruesomely so for low-amplitude fundamentals. And there is all that higher frequency energy to contend with. Also ugly is the high number of transitions per cycle.

By using the *magic code* method, you come up with a switch flipping pattern that looks like a fundamental sinewave. The waveform shown is one of the simplest you can build that has a strong fundamental, zero even harmonics, and a zero third harmonic. It has very few transitions per cycle. On the other hand, there's only one value available, and it has fairly strong fifth and seventh harmonics.

Note that classic PWM changes *both* sides of the bridge at the same time. Even for a comparable number of transitions per cycle, PWM has *twice* or more the losses.

In the simple example shown, the magic code requires only *four* single transitions per cycle. PWM would require *twenty-four* double transitions. While I can't claim this is "twelve times more efficient," I might say that those high-frequency transition losses are only 1/12th as much. And PWM often uses *much* higher frequencies for even worse performance.

Fewer losses, of course, let cheaper drivers be used, with lower temperatures and smaller heatsinks. Thus, the magic waveform method would seem to be better *if* you could locate some having lots of different amplitudes and low harmonics.

We saw last month that a magic half waveform of 00101111111010 has no DC term, no even harmonics, no third and fifth harmonic and a fairly weak seventh. To pick up he other half, use a code f 00-10-1-1-1-1-1-1-1-10-10. Do *this b* reversing the bridge to run he current *backward* through the notor winding.

Go through the 30-bit *math*, and you'll also find that the *waveform* 000110111101100 has an*mplitude* of about 83 percent*nd that* 000101011010100 has a*nplitude* of about 62 percent. Th*qual to* 69 and 38 percent pow*ile still* keeping a zero third a*h har*monic. Plus, of course*s the* good old trivial 000000*0000* waveform for the zero *e.*

This gives us four a*to* work with at 30 bits. F*ap*plications, you'll want *re* than this. The obvious t*s* increase the number c word. It turns out that w *products* of low har force all of those harmo

The most obvious n point is a 105-bit half w

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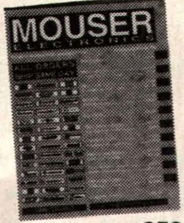

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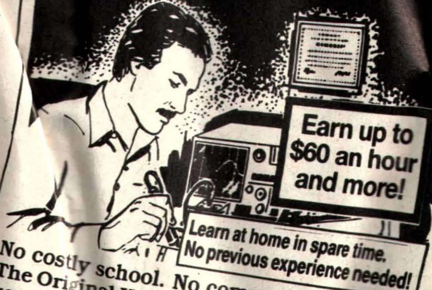
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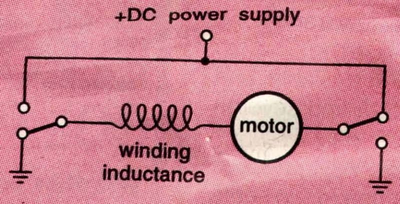
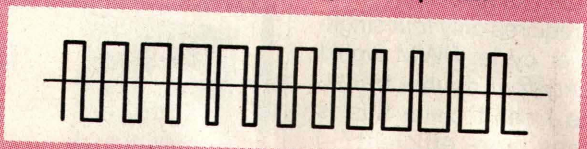
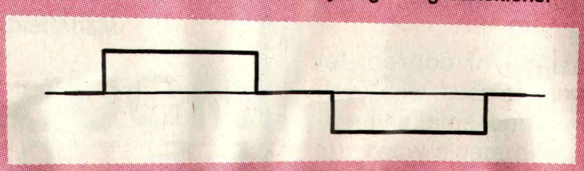


(A) The object of the game is to flip the switches as few times per cycle as possible, while still convincing the motor it is seeing a clean sinewave having the desired alternating current frequency and amplitude.



(B) With the "PWM" method, a high frequency carrier gets integrated by the motor's inductance to produce the desired waveshape. While amplitude is easy to adjust, there are many efficiency degrading transitions.



(C) With the "magic waveform" method, a shape having a desired fundamental and acceptable harmonics gets used. This example has no third or even harmonics. The transitions are few, but it is tricky to find useful values.

FIG. 4—TWO APPROACHES to high power variableamplitude sinewaves.

3 × 5 × 7 equals 105. Now, there are a *lot* of possible 105-bit words. But it turns out that only a mere 2219 or so of them end up with zero third, fifth, and seventh harmonics. These also have zero ninth, fifteenth, and twenty-first harmonics with no DC term and no even harmonics. This means that harmonics 0, 2–10, 12, 14–16, 18, 20, 21, and 22 are all zero—not half bad.

Some of the magic sinewaves will have too much distortion. Others will have too many transitions. And yet others won't hit the amplitudes we want, or might cause amplitude jitter.

But if you go through the list, you can pick out 103 or so magic sinewaves from the list in Fig. 5. These give you roughly one percent amplitude control. And they have far fewer losses than PWM.

To use this list, you "unfold" the strings to get magic words of length 210. You then stash these in a table mory somewhere. Pick a magic word for an amplitude. Pick a sected delay for a frequency. And at's all there is *to* it. If really needed, the few "missing" words in Fig. 5can be calculated by going to 420 lits.

I do this with PostScript and an Apple IIe. ow else are you going to exhaustiy explore all possible 210-bit bry words? As always, I've founstScript's friendly interactivity t *the* way to solve a seemingky problem.

As witticky problems, once you get things simplify a lot. For insto end up with zero even ha you must have halfwave s which means that you rearting with 105-bit words-wave symmetry makesnalysis because it results only. Thus, you are doit words. Always deal bit by splitting a zero.

Asults—a mere 4,50,496 states to

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run a full Fourier series on. All in all, this still might make for a fairly long Postscript evening. But wait. You can easily write 17 equations that force a zero third harmonic, and 10 equations for a zero fifth harmonic, and seven for a zero seventh harmonic. Thirty four equations in 52 unknowns should, in theory, reduce to one equation in 18 unknowns—262,144 states or so.

However, these are *general* equations. But *all* of our inputs and *all* solutions have to end up *binary* ones and zeros. You can thus eliminate some of these 52-bit words immediately and test for the rest. That quickly generates all 2219 possible candidates. You then run your Fourier Series only on the good ones, leaving you with a few hours work at most.

Full details appear on *GEnie* PSRT in FOURIER.PS, ZEROHARM.PS, and SN210CAT.PS. Plus a few others.

Many thanks to math genius Jim Fitzsimons for his valuable input on all this. Consulting services are available for this exciting new hacker topic. A kit or two may also be in the works. Surely others have plowed some of this ground before. If you know of any technical papers on power waveform harmonics, please send them to me for a free copy of my *Incredible Secret Money Machine II* book.

Now, the real challenge is to find the improved 440-bit magic word list. That should give us fewer losses, lower distortion, and more choices, yet still keep reasonable 26.4 kHz switching frequencies. This one might take a tad longer, though...

New tech lit

Sony has published new data books, including *Multimedia Computer Audio/Video, CCD Area Sensors, CCD Linear Sensors*, and *Radio Communications ICs*.

Motorola has a new *Rectifier Applications Handbook*. It includes some mind numbingly obsolete fil-

NAMES AND NUMBERS

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4010 Moorpark Avenue Ste 105M
San Jose CA 95117
(408) 248-1353

CRB Research
PO Box 56
Commack NY 11725
(800) 656-0056

Dialog Information Svcs
3460 Hillview Ave
Palo Alto CA 94304
(415) 858-2700

Electric Spacecraft Journal
73 Sunlight Drive
Leicster NC 28748
(704) 683-0313

GEnie
401 N Washington St
Rockville MD 20850
(800) 638-9636

Historically Brewed
Historical Computer Society
2962 Park Street #1
Jacksonville FL 32205

Kleinhuis North America
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Worthington OH 43085
(800) 544-2105

McGraw-Hill Bookstore
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Motorola
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Phoenix AZ 85008
(800) 521-6274

SAE
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Warrendale PA 15096
(412) 776-4841

Science/AAAS
1333 H Street NW
Washington DC 20005
(202) 326-6400

Scientific American
415 Madison Avenue
New York NY 10017
(212) 754-0550

Sony Semiconductor
10833 Valley View Street
Cypress CA 90630
(714) 220-9100

Spread Spectrum Scene
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El Granada CA 94018
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Synergetics
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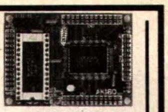
•MICRO MICON BOARD AKI–80



The AKI–80 is a Z84C015BF12 applied (CPU, PIO, CTC, SIO, CGC, etc.), Z80 software-compatible, high-quality 8-bit micon that can be installed in one tip.
The flat IC is not easily soldered, and has been already installed. AKI-80 <64K SRAM Ver.> *$40.00*
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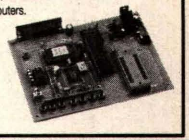

- Available for use with IBM PB-DOS/V personal computers.
- Corresponds to ROM2764, 27128, 27256
- Internal Z80 developing function

Contents:
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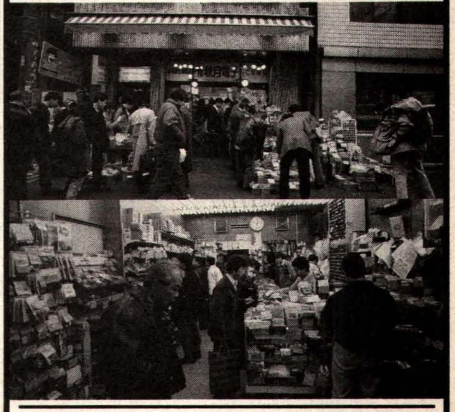
D-sub 28
Assembly technologe data collection for rom
WRITER Hexabinary software for IBM PC-DOS/V
with 3.5-Inch FDD



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This table of "magic" values can be used to generate efficient digital power sinewaves having very low distortions and minimum state transitions. Important uses include induction motor speed controls and electric automobiles...

```
00 - 00000000000000000000000000000000000000000000000000000
01 - Not available yet
02 - Not available yet
03 - Not available yet
04 - Not available yet
05 - Not available yet
06 - Not available yet
07 - Not available yet
08 - Not available yet
09 - Not available yet

10 - 00100000000000000000001000000000000001000000000100000
11 - Not available yet
12 - 00000000000000001000000000000000100000100000000000001
13 - Not available yet
14 - Not available yet
15 - Not available yet
16 - Not available yet
17 - Not available yet
18 - Not available yet
19 - 00001000000000000000100010000000001000100000010001000

20 - Not available yet
21 - 00000000000000100000100000000000000111000000000001100
22 - 00010000000000000100000100000001000000110000001000001
23 - 00000100000000000000100000100100000000001100100000100
24 - 00000000001000000000001001000000100000100000101100000
25 - 01000000000000010000010000000100000110000100000001100
26 - Not available yet
27 - 01000000000000010001000000000110000010001100000000110
28 - 00001000000000001000000001100010000000011000110000010
29 - 00000000100000000000011000001000001010000011000011000

30 - 00000000001000000010000010000110000000110000110000010
31 - 00100000000000010000010100000000001111000000000101100
32 - 00000001000000000010000011000001000100010010011000001
33 - 00000000100000000000110000000110000100001100100001100
34 - 00100000000000001100000001000011000001011000010000011
35 - 00000010000000000100010000011000100000100111000001001
36 - 00000000010000000001100000000111000000011100010000110
37 - 01100000000001000000010100001100000011000110000111000
38 - 00000001000000010000000100110100000010000011100100100
39 - 00000000000011000000000110010000011100000010011011000

40 - 00100000000010000010000011000011000001011000011100001
41 - 00001000000000001100000011000101000000111000110000011
42 - 00000000001000001010000010000111000001110000110000011
43 - 01100000000100000000011100001000100011100010001111000
44 - 00000001000000000001110000000011100010001110000000111
45 - 01000010000000000011000110000000110011100100001100011
46 - 01100000000010000000111000000110000111001100000111100
47 - 00000010000000001100000100110000110001100101100100011
48 - 00000000001000011000000011000111000001110001110000011
49 - 00100000000001100000000111001000001111000010011111000

50 - 00001000000000011000010001100010001110011000110001110
51 - 00000000010001000000101110000000111110000000111111000
52 - 00010000000000011100000001101110000001111011000000111
53 - 00000010000000011000010000111010001010001111100001110
54 - 00000000010000011001000000100111100000111100110000111
55 - 01100000000010010000011000011110000011001111000111100
56 - 00000000110000000000011111000000011111000000111111000
57 - 00000000100000100001101000001110001110001111000011110
58 - 00100000000100001100000101100011100001111000111100011
59 - 00110000000000110000001110011000001111100011001111100

60 - 00000000011000000011001001001111000000111100111100110
61 - 00010000010000010000011100100000011111100001101111100
62 - 01110000000000011000000111001110000011100111001111100
63 - 00000000010001000100010111000000111111100000111111001
64 - 00000110000000001000111000111000011011001111100011110
65 - 00000000110000000100111100010001110111000111011111001
66 - 00000000010000011010010000011111010001011111100001111
67 - 00100000000001110000000010111110001010111111010001111
68 - 00000000110000000100011111000000111111100001111111001
69 - 01000000001100000000111000001111100010111110011011110

70 - 01100000000000111010000001100111100011011110011001111
71 - 01110000000000100110000001110011100001111100111110011
72 - 00000000000110001100001001110011110001110011111110011
73 - 01100000000100000110011100000111110001111110010011111
74 - 00000010000001101000000011111100001111000111111111010
75 - 00000000000100111000001100111000111111000111011111110
76 - 00010000000010111000100001111110010101111111100011111
77 - 01110000000010001000101110001111000011111111001111110
78 - 00100010000000011100000001111101000111001111111101110
79 - 01100000000011000000001111000011110001111110011111110

80 - 00000001100000010011000111001110011100111111111100111
81 - 00000000000110011000011001110011011111011001111111110
82 - 00001000011000000000011110001110110001111111110111110
83 - 01110000000010001100001110011111100001111111110111110
84 - 00000000001100000110011100001111110001111111110011111
85 - 01100000000110000100011110010111110001111110111111110
86 - 00000010000001101100000011111000111111001111111111011
87 - 00000000000110100011101000011111101011111110011111111
88 - 00110001000000001110000111110011001111110111111110111
89 - 00000000101100000000111110010111101010111111111111110

90 - 00100010000000111100000011111010101111101111111101111
91 - 00000110000000101100101011111000111111011111110111111
92 - 01000100000100011100011001111011100111111111110111111
93 - 00000000001100111000110011100111111111110011111111111
94 - 00000100100000001111100101101110111111111110111111111
95 - 00110000000000111010100011101111100111111111101111111
96 - 00001100000001100011100111101100111111111110111111111
97 - 00000100100100000010111110110010111111111101111111111
98 - 00001000000010111010001011110101111111110111111111111
99 - 00000000010001110101000111011101111111011111111111111

100 - Not available yet
101 - 00000000111000000001111110001111110111111111111111111
102 - 00001100100000010001110111110110011111111111111111111
```

210-bit values shown in approximate one percent steps. Each listing consists of a zero followed by 52 active bits. To form the first half cycle, MIRROR the listing and REMOVE THE FINAL ZERO, giving a 105 bit half word.

To form the second half cycle, duplicate the first half, replacing each 1 with a -1, completing the 210 bit word. Do NOT mirror the second half!

To use, stash the words in a table lookup memory and pick the one you want.

More details (including full spectral analysis) in MAGIC210.PS, FOURIER.PS, ZEROHARM.PS and SNCAT420.PS on GEnie PSRT.

FIG. 5—103 MAGIC POWER SINEWAVES shown as one percent amplitude steps. Harmonics 2–10, 12, 14–16, 18, 20, 21, and 22 are zero. Harmonics 11 and 13 are tame. Minimum transitions are used for superb efficiency.

ter design information. Motorola completely missed the fact that you can *instantly* design any 60-hertz full-wave filter capacitor simply by memorizing this fact: In an 8300-microfarad capacitor, the *volts* of ripple equals the *amps* of current.

Marvin Simon's *Spread Spectrum Communications Handbook* offered by *McGraw Hill* does seem to be the definitive tome on the subject—all 1228 pages of it. This textbook clearly shows the military jamming heritage of spread spectrum communication, for it takes until page 1186 or so to get around to mentioning that there *might* be some commercial uses for this stuff. For a totally different approach to the same subject, check out Randy Robert's *Spread Spectrum Scene*.

Dave Strom has written a new *Power Up* book on making battery adapters for military surplus radios. It's published by *CRB Research*.

Scientific American, January 1995, has a great project on sonoluminescence in the *Amateur Scientist* section. Costs are in the hundred dollar range. Useful results should be obtainable in any fairly advanced home lab.

The fusion energy potential for sonoluminescence is talked about in *Science*, December 16, 1994, p. 1804. Sonoluminescence can routinely produce temperatures of a million degrees C and pressures of a 100 million atmospheres. All in a flask! Of course, I did tell you all about sonoluminescence long ago. More in HACK73.PS on *GEnie* PSRT.

Lots of information on *bright* blue light emitting diodes appears in the January 6, 1995 *Science* on pages 51–55. Few people are aware that LEDs are potentially five to ten times more efficient than an incandescent lamp. As auto taillights, LEDs are also *much* safer. That quarter second or so turn on risetime of an incandescent lamp translates to *twenty feet* of delayed warning at thruway speeds!

For information on speech synthesis and recognition, check into the AVIOS, or *American Voice I/O Society*. Its next applications conference will be September 12–14 in San Jose, CA. Journals, proceedings, and vendor's directories are also offered.

The *Electric Spacecraft Journal* is one interesting pseudoscience publication. There is also an *Anomalous BBS* on related off-the-wall topics.

Historically Brewed is that unique magazine offered from the *Historical Computer Society*. Trial issues are available for $3.

Free *P-Nut* connector samples are available through *Kleinhuis North America*. These are a long overdue improvement to wire nuts.

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Easy to build, RED Beam, visible for miles. Use for light shows, window bounce holography, cloud illumination and much more! **LAS1KM Kit w/1mw Laser Tube, Class II. $69.50**

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Clean up! With constant playing and using of degrading dry or wet cleaners, the output of your video tapes has slowly diminished to an unacceptable level and the VCR plays as if it has a head cold! The culprit is most likely clogged and dirty video and/or audio heads. The 3M Black Watch™ Head Cleaner Videocassette uses a patented magnetic tape-based cleaning formation to remove head clogging debris. No foreign substances such as cloth, plastics or messy liquids and no harsh abrasive materials are present. The cleaner's usable life is 400 cleanings or more!

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For the VCR! Once your VCR's record and playback heads are cured, and the unit plays like new, consider using the finest videocassette you can buy—the 3M Black Watch™ T120 Hi Pro VHS 4410 Videocassette. The 4410 is the highest performing videocassette available today for use with all standard format VHS recording hardware!

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VIDEOCASSETTE
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For most hardware hackers most of the time, patents are an utter and total waste that is *guaranteed* to cause you a net loss of time and money. The reasons behind this, along with fully tested and proven real-world alternatives, now appear in my *Case Against Patents* package. That also *includes* my *Incredible Secret Money Machine*. Details are found in my nearby *Synergetics* ad.

A reminder that unique downloads, freebie insider secrets, catalogs, and technical help are available on my *GEnie* PSRT. A 10-hour free trial time is available per the *Need Help?* box. A credit card is required to register.

As usual, the resources I've mentioned appear in either the *Names & Numbers* or *PIC Resources* sidebars. Be sure to check there first before calling our no-charge technical helpline. Let's hear from you. Ω

NEED HELP?

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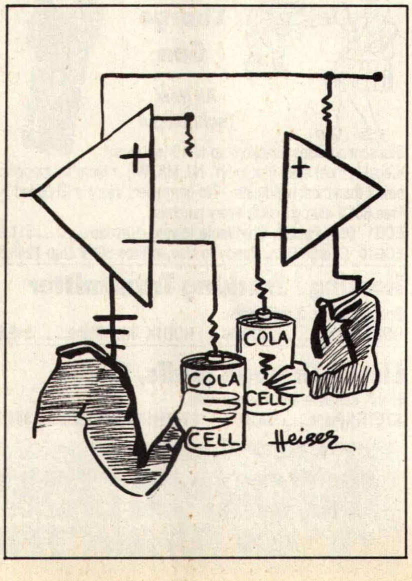
SYNERGETICS@GENIE.GEIS.COM.



AUDIO UPDATE

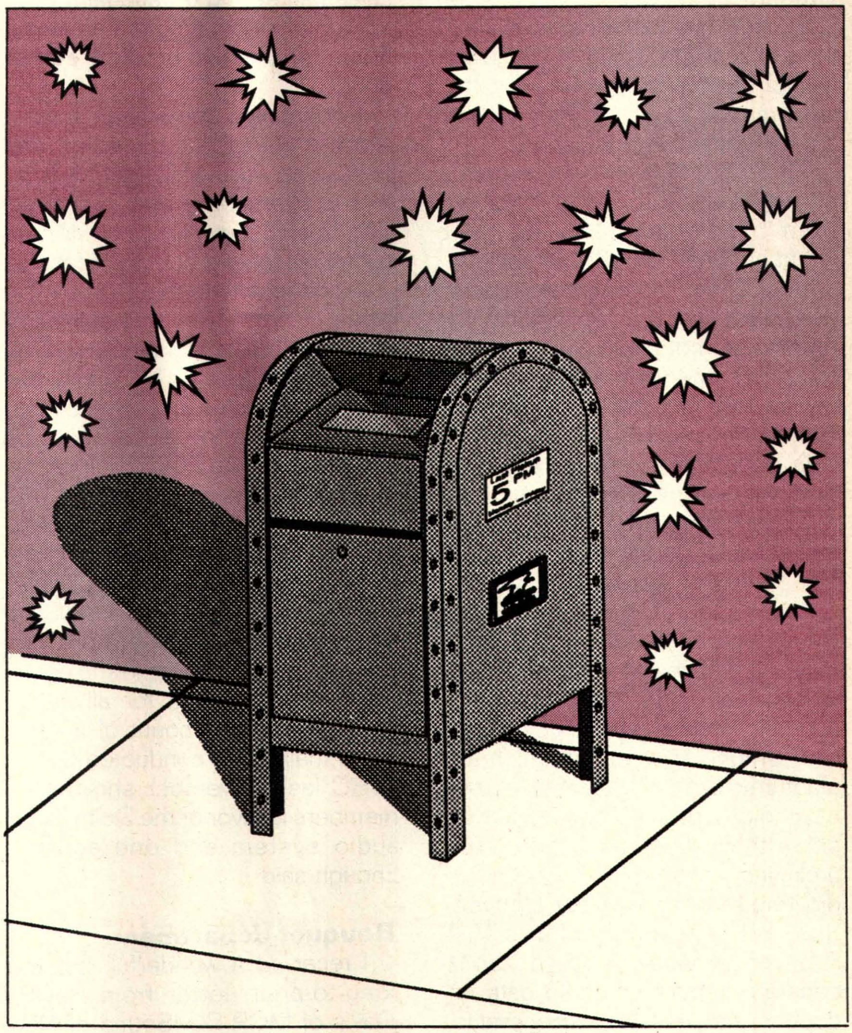
Letters: Bouquets and Brickbats

LARRY KLEIN

As regular readers may have noticed, one of my favorite critical targets is the publications that cater to the high-end audiophile purist crowd. And, not surprisingly, most of my *Electronics Now* mail is in response to those potshots. At present, I'm pleased to note, such mail is running about 3 to 1 in my favor—which testifies to the good sense of most of this magazine's readership.

In general, I don't think the purist (I-can-hear-it-even-if-you-can't) publications do grievous harm—other than encouraging those seeking quality reproduction to spend far more than necessary and engendering, by example, an anti-science dumbing down of their readers. Some favorite examples of their recommended, but scientifically implausible, products come to mind: the metal brick that when placed atop an amplifier improves its sound; the adhesive-backed, 1-inch, fuzzy discs that when cemented randomly to the walls of a listening room enhance its acoustic qualities; and a dozen or so brands of speaker cables that magically embellish an audio system's spatial coherence, resolution, speed, and/or harmonic integrity (if not convergence). None of those products appear to employ known laws of physics, acoustics, or electronics to perform its wonders—which opens the question of which alternate physical (or psychological) dimension it or its admirers operate in.

In any case, my generally good-humored attacks on the purveyors of audio excess have generated both bouquets and brickbats (in a 3:1 ratio, as I've noted). Herewith is an interesting sample brickbat from reader Vincent Knoll of Seattle, WA. Mr. Knoll is annoyed at my dismissal of *Stereophile's* concerns about the adoption of Dolby's AC-3 digital audio system for digital TV. His letter has been edited for space while (hopefully) preserving its tone and major points. Since the issues raised deserve replies, I've keyed my responses to his letter.



Mr. Knoll writes:

(1) Larry Klein's latest attack on *Stereophile* [Dec. 1994] was unnecessary to say the least.

(2) Far from being an exercise in arrogance, *Stereophile's* letter to Pioneer [on the AC-3 system] was one of valid concern.

(3) Do we really fail to hear those soft sounds buried under the louder ones? Maybe they do have some influence.

(4) Klein says he is more amused than upset [by *Stereophile's* open letter]. Really? I wonder, since his comments on *Stereophile* [to use his term] are becoming "prolix"! What?! I read an electronics magazine and improve my vocabulary too. Such a deal!

(5) Before Mr. Klein's obsession with *Stereophile* goes beyond prolix—he'll have to help me out here, I don't know a word for that concept—maybe you could persuade him to be more technical and less editorial.

(6) I enjoy both *Stereophile* and *Electronics Now. Stereophile* doesn't single out *Electronics Now* by name for repeated attacks. Please make the courtesy reciprocal.

My response.

(1) Unnecessary? As long as publications such as *Stereophile* continue to push bad science, bad logic, and unsubstantiated evaluations, I feel I'm doing a small but helpful service by pointing out the absurdity of much of their buying advice and recommendations.

(2) Perhaps. I receive a monthly self-promotional "news release" from *Stereophile* extolling their latest editorial content and achievements. Their "open-letter" objections were simply an opportunity for them to promote their publication to the press and their advertisers. In my day, we did the same thing at *Stereo Review*, but I tried to stick with substantive issues, e.g., the quality problems of records and prerecorded tapes, the audio industry's hanky-panky on power ratings, the FTC's irrational power rulings, etc.

(3) As I said in my original article, we know a lot about psychological masking and how to manipulate it to desirable ends. And psychoacoustic studies are ongoing, not only among the equipment manufacturers but in the electronics and psychology departments in universities throughout the world. (The preliminary program of the 98th Audio Engineering Society Convention, taking place in Paris this February, schedules no less than 11 separate papers on audio data reduction and its subjective evaluation.) To disregard the results of those ongoing studies, trials, and controlled listening tests on the basis of speculative "maybes" (and the unreliable opinions of self-anointed golden ears) is not how science works.

(4) I've been known to do so. But exactly what is your objection to expanding your vocabulary? If by reading my column you can discorporate dual avians with a single lithic formation, why not?

(5) "Logorrhea" is the word you want. I do try to maintain a balance between the technical and the "editorial." At least two-thirds of the column you complain about was "technical," but in any case, I don't see myself as a reporter, but rather as a commentator. Electronics news is handled very ably in other areas of *Electronics Now*.

(6) I refer you to response (1). I don't know how much "courtesy" is owed, for example, to a snake-oil salesman selling a fraudulent product, or when pointing out a publication's off-the-wall product evaluations.

Incidentally, I don't mean to leave readers with the impression that there is no worthwhile editorial content in *Stereophile* and *The Absolute Sound*, but technical silliness continues to sully both publications.

A final point on the Dolby AC-3 digital audio system that started all this: The Advanced Television Systems Committee (ATSC) has voted to accept the AC-3 system as part of the proposal on digital TV to be forwarded to the FCC for approval. The ATSC includes more than 50 companies, associations, and educational institutions involved in delivering television to the U.S. public. These include television networks, broadcasters, cable operators, motion picture companies—and equipment manufacturers for all of the above. An official count of the six-week mail ballot conducted by the ATSC last November showed 40 members in favor of the Dolby AC-3 audio system and one against. Enough said.

Bouquet department

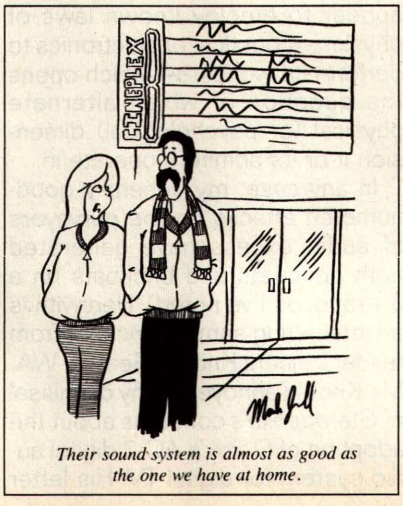
I received a wonderful, but too-long-to-print, letter from Haynes Davis of MCP DaviSound of Newberry, South Carolina. Mr. Davis, who is a professional audio design engineer, tells an interesting tale of two prototype preamps, one of which received raves from a high-end reviewer for its "well-defined low end," "high degree of imaging," "silky smooth high end that reproduces the 'velvety' characteristics of the string section," etc. and so forth. The unfortunate other unit was judged to suffer from a variety of sonic inadequacies and nasties that clearly disqualified it as a truly hi-fi product. The kicker is that they were both primarily off-the-shelf bi-fet op-amp designs from the same textbook circuits using the same high-grade parts and layouts. True, the two units did use different face plates. Perhaps the prettier face won the sonic beauty contest?

Mr. Davis closes with a request that I "continue to educate the masses along these lines from time to time via your column and may logic prevail." Pleased to comply!

Another reader, Professor Gerald L. Park from the Department of Engineering at Michigan State University, recounts some of his past experiences building kits (prompted by my column on the subject) and laments the fact that the reduction in experimentation and building is very noticeable among his engineering students. He suggests that I "keep the good words flowing and don't be afraid to offend the gurus of dollar-fi—the modern version of hi-fi wherein high cost is a positive performance parameter."

Professor Park concluded with an interesting speaker-cable suggestion: "You might suggest to your readers that they consider SO type extension cord cable used for boats (yellow jacket) or in industry (black jacket). They often use #8 gauge stranded wire and differ very little from higher-priced oxygen-free [?] hi-fi cables. A few measurements with an audio-spectrum analyzer [HP 3561A] confirmed that conclusion."

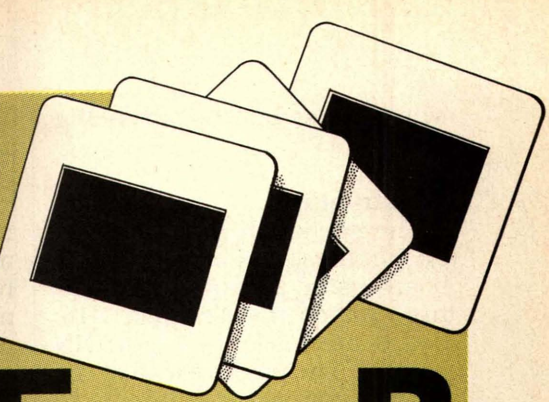
Thank you, Professor Park, and all the others who have taken the time to write and let me know your thoughts. I appreciate your comments, whether we agree with each other or not. Ω



Their sound system is almost as good as the one we have at home.

JOHN W. SWANCARA

THE SLIDE STEPPER



Put on an automatic slide show with this simple stepper circuit.

THE REQUIREMENTS FOR THIS project were determined when our club historian assembled a slide show to run during an upcoming banquet. Everyone wanted to eat, and no one wanted the responsibility of operating the slide projector and advancing the slides. Unfortunately a slide projector that would sequence them automatically was not available. The circuit described here solved the problem by adapting a standard carousel slide projector for automatic operation. Only the remote control cable that plugs into the slide projector must be modified—the projector is left in its original form.

The circuit for the unmodified remote control of the Kodak carousel projector is shown in Fig. 1. The remote originally provided forward and reverse advancing of the slides. It was replaced by a variable timer and a relay that simulated the remote's forward switch and controlled the projector.

Theory of operation

The timer circuit is shown in Fig. 2. A 555 timer, IC1, is the heart of the circuit. The value of resistor R3 determines a minimum time delay, and potentiometer R4 sets the maximum delay. The values indicated provide a time delay that is variable from 1 to 15 seconds. If only one time delay is required, R3 and R4 may be replaced with one equivalent fixed resistor. The reset time of IC1 is sufficient to energize relay RY1 for a duration roughly equivalent to a person momentarily depressing the forward button on the original remote control. Resistor R1 provides current limiting for the 5-volt reed relay, also extending the life of the battery.

No power switch is required. Power is supplied by a 9-volt battery (B1) and it is switched on when pins 1 and 4 of DIN plug P1 are shorted by DIN jack J1 as shown. The circuit works only when connected to the projector. This saves parts and labor and eliminates the chance of forgetting to turn off power

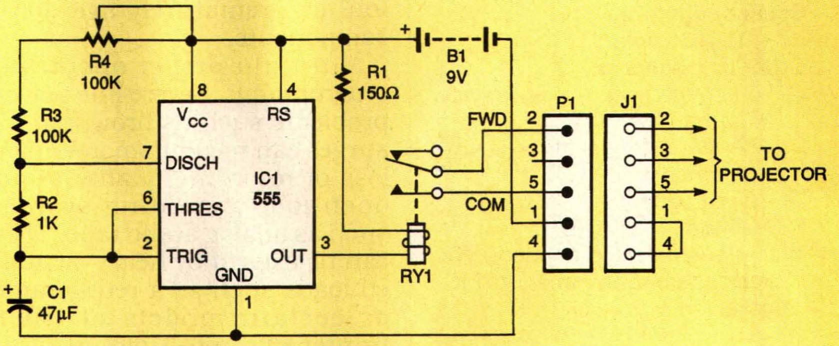


FIG. 2—SCHEMATIC DIAGRAM. The stepper circuit replaces the remote and will automatically advance the slides with a variable time delay.

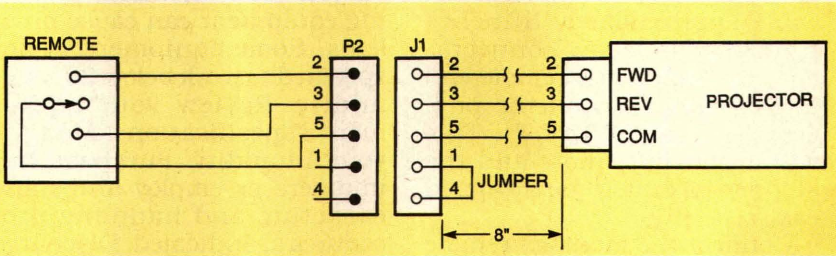


FIG. 3—CABLE MODIFICATION. This will allow the remote and the stepper circuit to be swapped easily.

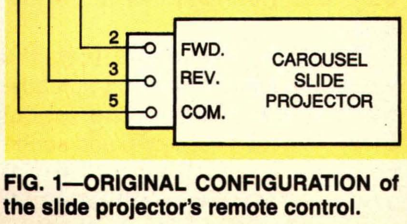


FIG. 1—ORIGINAL CONFIGURATION of the slide projector's remote control.

when the stepper is not being used.

Construction

The parts can be assembled on perforated construction board using point-to-point wiring. All connections to the board are made to 5-pin DIN plug P1. The positive lead of the battery connector connects to the circuit board, while the negative lead connects to pin 1 of plug P1. The board can be installed in any suitable case, as long as there's room for the 9-volt battery, too.

PARTS LIST

All resistors are ¼-watt, 5%.
R1—150 ohms
R2—1000 ohms
R3—100,000 ohms
R4—100,000 ohms, potentiometer
Capacitors
C1—47 µF, electrolytic
Semiconductors
IC1—TLC555 timer
Other components
J1—5-pin DIN jack (or equivalent connector)
P1, P2—5-pin DIN plug (or equivalent connector)
B1—9-volt battery
RY1—5-volt, SPST relay
Miscellaneous: 9-volt battery clip, circuit board, case, one 8-pin IC socket

The projector's remote control cable must be modified to work with the timer circuit. Cut the cable approximately 8 inches from the projector connector end. Reconnect the remote end to DIN plug P2, and the projector end to DIN jack J1. This will allow the remote and the stepper circuit to be swapped easily.

Connect the modified remote control cable to the projector and make sure that the forward and reverse functions of the remote control still work. With the projector turned off, disconnect the remote from J1 and connect the stepper circuit. You should hear the relay click with a steady time delay. Potentiometer R4 should vary the time delay. Now you can turn on the projector, set the advance delay, and join the party. Ω

MAGNETIC STORAGE

continued from page 68

magnetized screwdriver near magnetic heads. Magnetic heads should be cleaned and demagnetized according to manufacturers' specifications.

The effect of a dirty head varies greatly in different storage technologies. Floppy disk drives rarely fail due to dirty heads, whereas many tape drive failures can be corrected simply by cleaning the heads.

Laboratory-grade alcohol and a cotton swab will clean most recording heads and tape paths. Special cleaning and demagnetizing kits are available for the various media. These kits use alcohol substitutes due to regulation of shipment of flammable substances. Avoid using rubbing alcohols containing oily lubricants that can foul or prematurely age drive components.

Maintain proper operating environment. Severe line power problems such as brownout or surges can result in momentary loss of recording quality in an open-loop recording system such as analog audio tape. This can be caused by heavy switched loads such as a refrigerator or certain models of laser printer sharing a circuit with recording equipment.

In dry climates static buildup on your body or inside recording equipment can cause problems. Some equipment is not specified to work below 20% humidity. Review your equipment's specifications. Monitor your humidity. Purchase humidifiers or employ anti-static carpeting and handling procedures as indicated. Discharge your body before handling magnetic media.

Park your media. Tape media should be parked at the beginning of tape position or at the end of tape position before being removed from the drive.

Long term storage of a cartridge in a drive can cause the drive or cartridge roller hubs to deform. This deformation can be repaired by performing multiple retension passes. Ω

EQUIPMENT REPORTS

continued from page 14

penser tube under precisely controlled air pressure. The amount of time that the air pressure is applied to the dispenser is also precisely controlled and can be varied to adjust the amount of solder paste deposited on a board.

Surface-mount components are difficult to handle, and conductive tools such as tweezers can damage parts that are sensitive to electrostatic discharge or ESD. An SMD (surface-mount device) vacuum handling tool is also included with the SMD-250 to eliminate the danger of ESD damage. Interchangeable vacuum tips are used to pick up and place all kinds of surface-mount parts. Vacuum is applied to pick up and place the part, and when the part is in position, the vacuum is released and the part stays put.

A hot thermal jet-flow attachment allows a temperature-controlled blast of air to be directed at SMD parts to melt the solder paste. This allows surface-mount parts to be replaced without heating the entire board.

Holder assemblies mount on the top of the SMD-250 to hold the accessories when they are hot. A wet and dry tip maintenance kit is also included that mounts on top of the unit to keep all kinds of tips clean and ready for use.

The front panel of the SMD-250 contains most of the unit's controls and displays. A lighted on/off switch indicates when power is on. Two separate temperature displays can show the exact temperature of any two attachments. Pushbuttons allow exact temperatures to be set by the user.

With a list price of $1995, the SMD-250 is competitively priced. Anyone who is running a modern electronics repair shop will undoubtedly need the capabilities of this machine.

Repairing PC boards with the wrong equipment can end up causing more damage than one set out to repair in the first place, and so the SMD-250 could pay for itself in time saved and in damage not done. Ω

LETTERS

continued from page 12

POWER CONTROLLER SAFETY CONCERNS

I read with interest Richard Roane's "Power Controller" article (*Electronics Now*, January 1995). It is a clever microprocessor-based board for controlling eight channels of 120-volt loads at various power levels. However, as a licensed industrial electrician, I'd like to point out a few safety considerations with regard to projects powered from the 120-volt ACline.

First, unless 14-gauge wiring is used throughout, an appropriately rated fuse should be added to protect the wires from overheating and from accidental overcurrents. In any case, an 18-gauge wire is the minimum wire size that should be used.

Second, the "neutral" wire must be identified. It mist be distinguishable from the "hot" wire. This can be done by color-coding the wires. The neutral wire should always be white and the ground wire should always be green, but the hot wire can be any color except white or green.

That color coding should be clearly marked on the schematic as well. If it is ever necessary to troubleshoot the board, you'll appreciate the coding. It always helps to know what's on a board before you start building a circuit.

The hot wire should go to the main terminals (MT1) of the triacs. The neutral wire should go to J2, for connecting to the various loads. That was correct in the Power Controller schematic but wrong on the foil pattern. Confusion like that always stems from not identifying the wires in the first place.

Third, the article does not mention enclosures. I've seen far too many circuits like this one that are either put in a flimsy wooden box of some sort, or they are not put in any enclosure. The electrical code is very clear on this: An enclosure must be provided. The enclosure can be made of any material as long as it is not flammable. That means that wood is unacceptable, as are many plastics. Metal is best.

If you are considering the use of a plastic enclosure and don't know if it's flammable or not, shave off a thin strip from it with a knife put it in a match flame. If the strip burns, don't use that enclosure.

Fourth, the ground wiring from the Power Controller's input power cord need not go to the PC board, as the schematic indicates. It is earth ground, not circuit ground. Its purpose is to connect metal parts of your equipment to the earth. If a metal enclosure is used, then you would ground it. If your enclosure is plastic, leave a lug so the ground wire is available if it's needed for light fixtures or other equipment that connects to your circuit.

These pointers are not meant to discourage electronics enthusiasts. However, a sense of responsibility and attention to detail will help in making your project safe. This will not only benefit yourself, but the people around you—members of your family, and others you care about.

JIM STEINMAN
Kitchener, Ontario, Canada Ω

Q & A

continued from page 9

small, but you can use 1¼ inches of ordinary No. 20 copper wire, which has a resistance of 0.0008 ohm per inch. Be sure to make excellent solder joints. For best results, place the shunt a few inches away from the meter, and run wires to the meter from it; the reason is that when 50 amperes flow through the shunt, there will be an appreciable magnetic field, which could make the meter read wrong. Also, make measurements only momentarily, because the shunt will get hot.

SCANNER MODS WANTED

I'm using a Realistic Pro-57 programmable scanner which has several bands of frequencies that are blocked off, including FM broadcast stations, TV broadcasts, VHF airline and military frequencies, and cellular phones. Could you suggest an easy way to modify this receiver so that there are no blocked frequencies within its desired range?—T. Rozzi, Norwalk, CT

There are two reasons why a digitally controlled receiver may not get a particular range of frequencies: either its front end isn't designed to let them in, or its microcontroller isn't programmed to tune to them.

Federal regulations require cellular phone frequencies to be blocked out by programming the microcontroller not to tune to them, even though the front end and the rest of the radio may work just fine on those frequencies. By law, this "blockout" must not be easy to undo. As you should know, listening to cellular phone calls is illegal in the United States.

FM and TV signals are blocked out because they're too strong! A well-designed scanner will have a front end that rejects these frequencies so that it doesn't go haywire when you get near a high-power TV station. FM broadcast and TV sound signals are much wider in bandwidth than the signals your radio is designed to demodulate. Similarly, VHF aviation signals are AM and your radio would not demodulate them.

INTERMITTENT RECORD PLAYER

I have a 22-year-old stereo system. The sound from the radio portion is fine, but when I play a record, the sound is uneven, often alternating between two speakers or coming out of only one speaker. How can I correct this problem?—E. Chambers, Jr., Pittsburgh, PA.

Look for loose connections in the cabling from the phono cartridge to the amplifier. It may be as simple as a plug loose in its socket—but more likely, there is a break in the thin wires inside the tone arm. After all, they move around every time you play a record. Another possibility is a defective cartridge or stylus (needle). Still another possibility is that the selector switch might not be making good contact when you switch from radio to phono. Try turning it back and forth a few dozen times; if the problem diminishes, the switch should be cleaned or replaced. Ω

PROCAR SYSTEM

continued from page 79

door switch. Ford, and other car makes with positive switching, have three wires. One wire is connected to the positive side of the battery, the second is typically to a a "key-in-the-ignition" buzzer, and the third is for lights.

Check out each wire with a test light. With the door switch depressed, turn the dashboard domelight switch on and off, observing which wire from the switch turns on the light. After identifying the door wire, turn off the dashboard domelight switch and release the door switch so the domelight remains on.

Cut the wire about two inches from the switch; the domelight should go out. Connect the short wire from the switch to the brown wire from pin 11 (DRI, Driver door) of the Logic Module. Connect the other end to the gray wire to pin 12 (PAS, passenger door) from pin 12 of the Logic Module.

The Logic Module must be programmed for the specific host vehicle. Remove the four screws and cover from the Logic Module to expose its circuit boards. There are header pins on the Alarm board for the driver's side and passenger doors for (+) and (−) switching. Then program both doors for + switching.

Negative switching

Identify the door light switching wire. Verify that all car doors and hatch or trunk are closed. Open the driver's side door, and remove the door switch. On General Motors and other cars with negative switching, there will be two wires to the switch. One will be for the "key-in-ignition" buzzer, and the other will be for the domelights. With the switch removed, the dome light will be out.

Touch one wire and then the other to ground. Cut the wire that turns the light on about two inches from the switch. The short wire from the switch connects to the brown driver's side door wire from pin 11 of the Logic Module. Connect the other end to the gray passenger side door wire from pin 12 of the Logic Module.

Test and checkout

The fourth installment of this article will include a 29-step test and checkout procedure to determine the fitness of your completed ProCar system. It will also contain an "instruction manual.

"It is recommended that a copy of that text be kept in your car at all times as a reference when teaching ProCar system operation to authorized persons and as a personal refresher course in the features of the Procar security system. Ω

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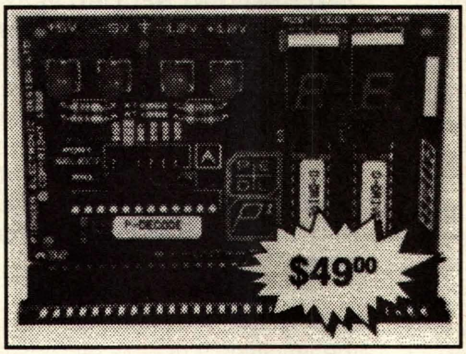

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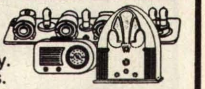

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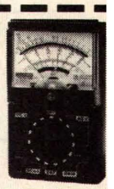

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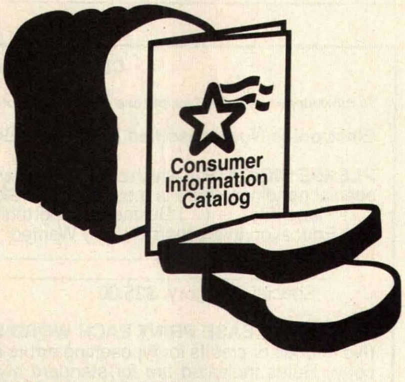

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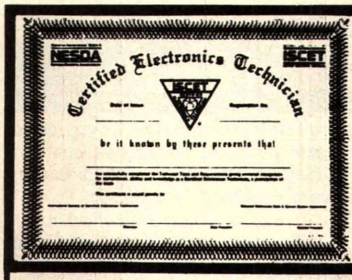

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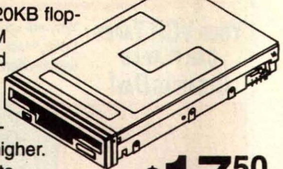

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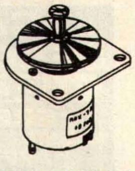

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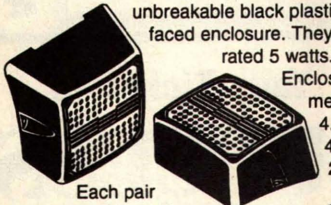

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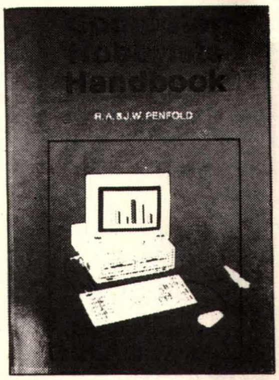
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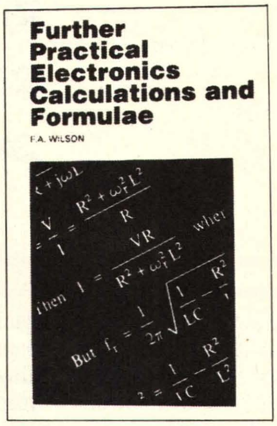
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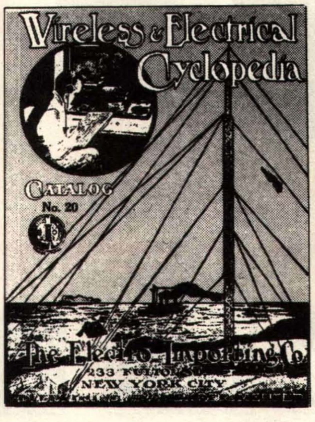
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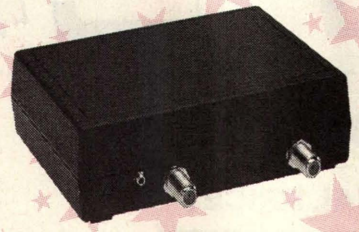

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7815K	1.79
7824K	1.79
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78M15	.59
78M24	.59
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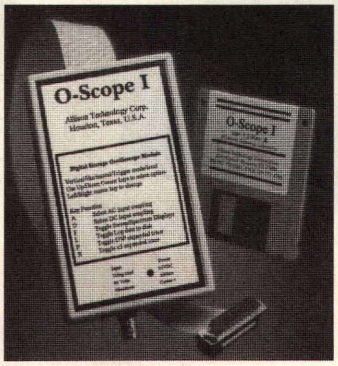

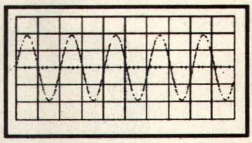

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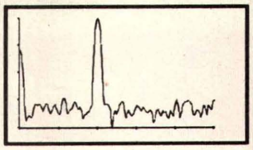

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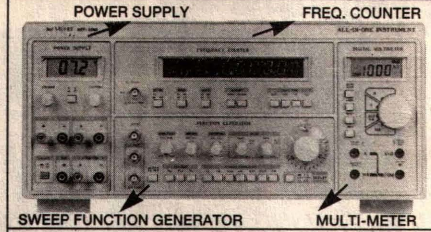

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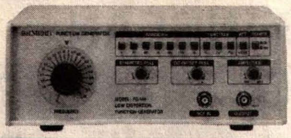

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- Variable DC Offset Control

2MHz Sweep Function Gen. w/Freq. Counter

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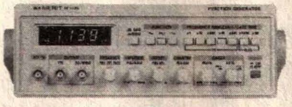

- 4 Digit LED Display
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- 10 MHz Freq. Counter

1.0GHz Frequency Counter, High Resolution

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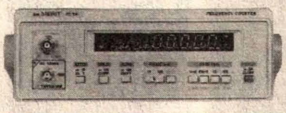

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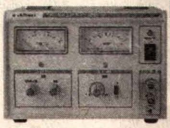

PS-500 DC Power Supply

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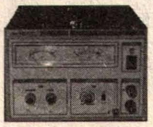
- 0.1 ~ 3A
- Short & Overload Protection



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- 0.1 ~ 10A
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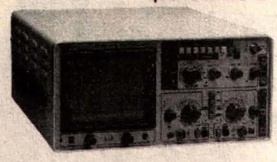

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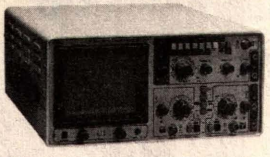


OS-3344 *Reg. $899.* **$649.00**

OS-3304 25MHz, Dual Trace

1
- DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV
- **60MHz (X1.X10) Probe Kit: 2 sets**
- Power: 115/230V AC

OS-3324, 3 Function

1 • OS-3304

2 • Dual Component Tester/Comparator

3 • Triple DC Power Supply 5VDC, +12 VDC, -12VDC

OS-3344, 5 Function

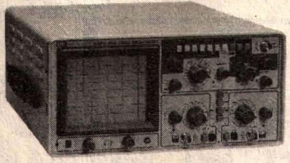
1 + 2 + 3 • OS-3324

4 • Frequency Counter 100MHz, 7 Digit LED Display

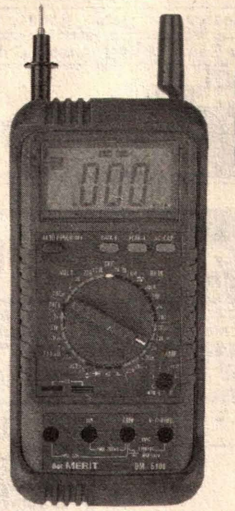
5 • Function Generator 0.02 Hz to 2.0 MHz

OS-3315 40MHz, Dual Trace Sweep Delayed

Reg. $799. **$549.00**



- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1.0S 7 decade
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 2mV/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV
- Variable Hold Off
- 16ns ~ 1.0s Time Base
- **60MHz (X1.X10) Probe Kit: 2 sets**
- Power: 115/230V AC



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DM5100

Reg. $149.

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including Deluxe Holster

Features (DM5050C/DM5100)

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- Alligator Clip Test Leads
- Lead Holders/Velcro Strap Holster

DM5050C, DMM + Capacitance

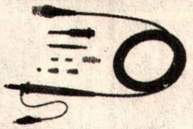
- 9 Function / 42 Range
- Multimeter
  Ohm: Up to **2000MΩ**
  Amp: AC/DC 2 Amp
- Extended Capacitance Meter (9 Range)
  0.1pF - 20,000μF
  Zero Adjust Knob
- Trig Lamp

DM5100, Wide Range w/Logic

- 11 Function / 45 Range
- Auto Power Off
- Data Hold & Peak Hold
- Freq: Up to **20MHz**
- Amp: Up to **20A AC/DC**
- Ohm: Up to **200MΩ**
- Capacitance: **1p - 200μF**
- Logic: TTL, TR hFE

Oscilloscope Probe Kit

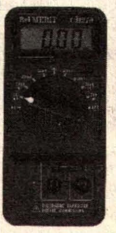
Switch Selectable X1/X10



HP-9060, 60MHz *Reg. $29.* **$19.00**
HP-9150, 150MHz *Reg. $49.* **$29.00**
HP-9250, 250MHz *Reg. $59.* **$39.00**

Capacitance Meter

Reg. $79. **$49.00**



CM210
- 3 1/2 Digit LCD
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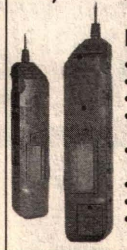

DM150
- 3 1/2 Digit
- Dual Display
- Auto & Manual
- DCV, ACV, ACA, DCA, Ω
- Logic CMOS/TTL
- Data Hold
- Diode
- Continuity

Multifunction DMM

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DM3050
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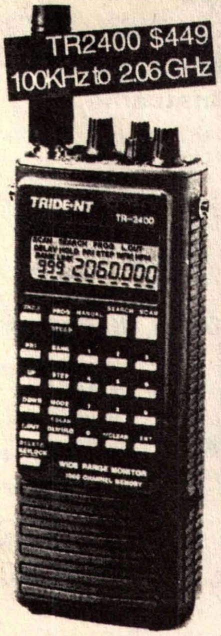
TR2400 $449
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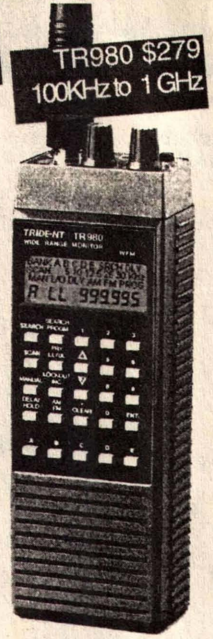
TRIDENT
TR-2400
WIDE RANGE MONITOR


TR980 $279
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TRIDENT TR980
WIDE RANGE MONITOR

BC220 $229
Turbo Scan
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uniden Bearcat

BC2500 $319
25MHz to 1.36 GHz
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ATS803A $145
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Shortwave Receiver
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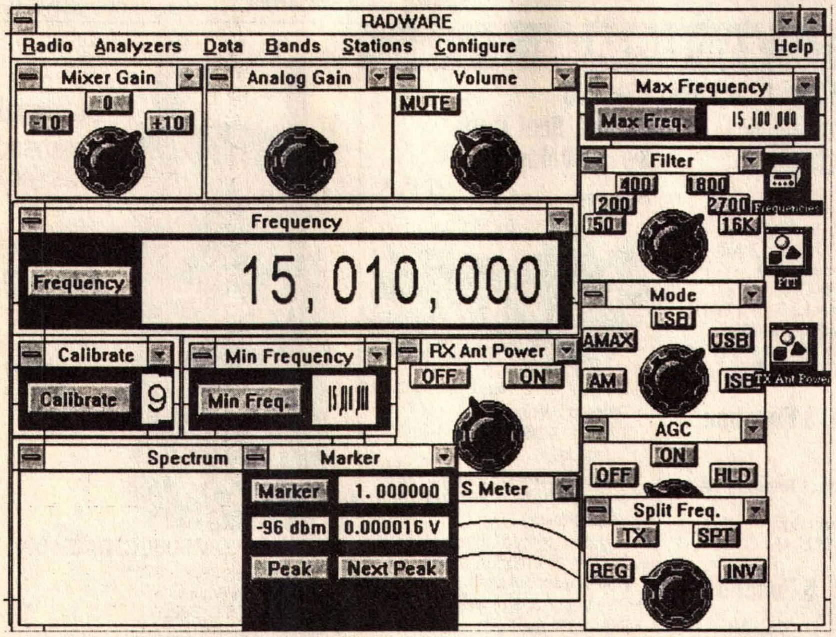
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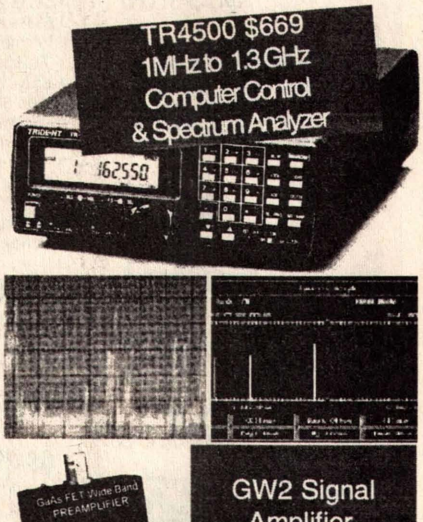
0
+10
Analog Gain
Volume
MUTE
Max Frequency
Max Freq.
15,100,000
Filter
400
1800
200
2700
50
16K
Frequencies
Frequency
15,010,000
FFT
Mode
LSB
AMAX
USB
AM
ISB
TX Ant Power
Calibrate
9
Min Frequency
Min Freq.
RX Ant Power
OFF
ON
AGC
ON
OFF
HLD
Spectrum
Marker
1.000000
-96 dbm
0.000016 V
Peak
Next Peak
S Meter
Split Freq.
TX
SPT
REG
INV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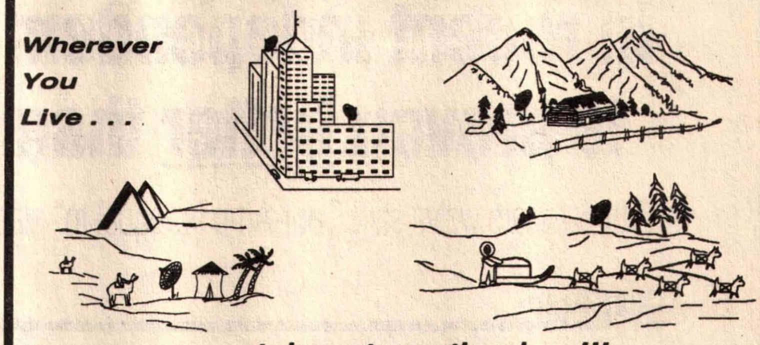

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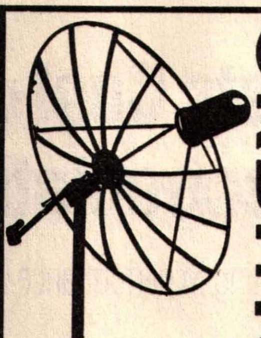


Known the world over for their superior reception and picture quality, the Orbitron satellite dish features an exclusive Spinclination mount, which allows declination to be set by rotating the antenna to correct the latitude setting on the scale. Their compact shipping cartons allow these antennas to be shipped very economically to any point in the world. Let Orbitron help you expand your viewing choices.

1514001	6.7'	SX-7	Polar/Spin	$45 (S&H)	$259
1514002	8.3'	SX-8.5	Polar/Spin	49 (S&H)	319
1514004	10.0'	SX-10	Polar/Spin	63 (S&H)	449
1514005	11.7'	SX-12	Polar/Spin	84 (S&H)	649

and many more...

Pico Peaker

You can now accurately aim your satellite dish to receive ***all*** the satellites using a tool the experts use. Whether installing a new system, moving your dish, or realigning your dish due to wind or frost, the Pico Peaker will save you both time and money. This unit can be used on any receiver system with block down-converted frequencies between 400 and 1450 MHz. It will also eliminate the need for those expensive service calls. The unit includes everything you need—even the cables. A *"must"* for every satellite enthusiast.

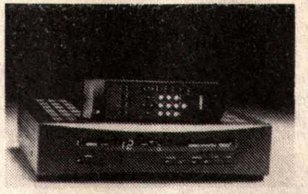
900038 Pico Peaker S&H $5 $89.95

Superjack Actuators

Is your actuator no longer doing its job because of wear and tear? As the hardest working part of your satellite system, the actuator must move your dish from east to west across the entire satellite belt. Each time you change satellites, your actuator sends pulses to the receiver telling the receiver when to stop moving the dish. Most older actuators sent only 10-16 pulses for each inch of travel, which may not be enough to stop the dish at the maximum signal strength. Today's new heavy duty actuators with high resolution reed sensors send 48 pulses per inch of arm travel.So if your old actuator is getting tired, let a new SuperJack insure the finest picture possible.

18" arm	1019018	S&H $15	$ 89
24" arm	1019026	S&H $16	139

uniden®

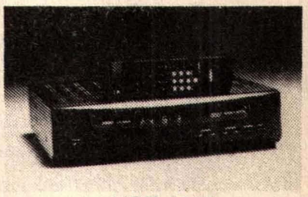


Ultra

The Ultra is Uniden's newest, smallest fully-integrated C/KU receiver ever. This unit includes the ability to control dish movement and is ready for an optional internal program decoder. The Ultra comes preprogrammed for 49 satellite positions and allows you to add satellites as they are launched. Move directly to the satellite by entering the abbreviation from the included infrared remote control. Forty programmable favorite channels can be accessed immediately from your easy chair. Run across something you don't want your kids to see? Just touch a button and eliminate that channel from their access. A complete variety of color menus allow you to control everything from your remote control. The Uniden Ultra is an ideal receiver to get you started in Direct-To-Home Satellite TV.

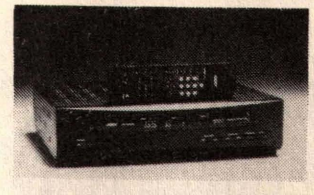
4527008 Ultra S&H $22 $379.00

The UST 4600 sets a standard in value and performance for home satellite receivers. This unit features automatic satellite programming, 160 favorite channels can be instantly recalled for easy access. All 160 can be changed or updated at any time. This IRD features a stereo processor, enabling you to tune both left and right channels for a full stereo effect from over 100 radio stations found in satellite. The QuikTune feature quickly optimizes the satellite picture for the sharpest image. The 4600 offers other features including IR/UHF remote, 55 satellite position memory and direct satellite access. The versatility makes this an excellent choice.



UST 4600

4527009 UST4600 S&H $22 $499.00



UST 4900

The Uniden UST 4900 is one of the most sophisticated satellite television receiver systems available today. This receiver will open your home to the universe of satellite viewing and is designed to be one of the most user-friendly IRDs available anywhere. Sophisticated microcomputer technology brings in crystal clear audio and video broadcasts with a minimum of user effort. The UST 4900 front display features easy-to-read icons that show you vital information including satellite, channel, polarity, timer status, antenna position and much more. This receiver is capable of storing the positions of the satellites, as well as the tuning details for each channel. The picture-in-picture feature allows you to view two video sources at the same time. You can have it all, including advanced technology and lasting quality, with the UST 4900.

4527010 UST4900 S&H $22 $689.00

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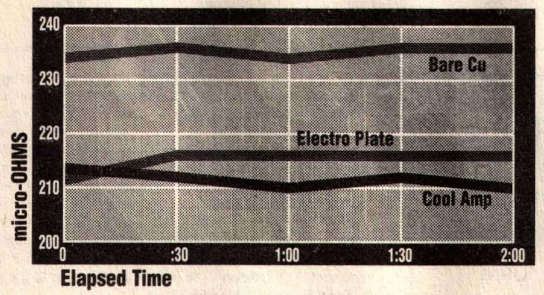
(For 50 years we've said Cool-Amp is "equal to" electroplating in performance. It is better.)

Cool-Amp

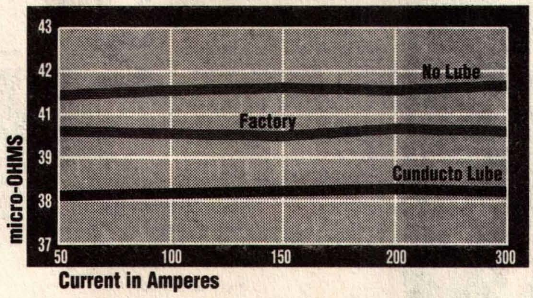


From the report:

"...compare the conducting properties of Cool-Amp silver plating compound with factory silver elctro-plated bus and bare copper bus.

"The test results indicated that the contact resistance of the Cool-Amp plated bus connection was slightly lower than that of the electro-plated bus connection and much lower than that of the bare copper bus connection. The final temperature at temperature equilibrium of the bus connection employing Cool-Amp was slightly lower than that of the electro-plated bus connection and the bare copper bus connection..."

Conducto-Lube



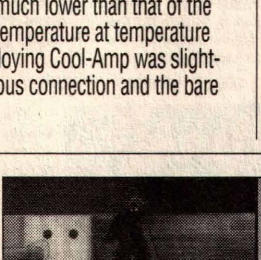
From the report:

"...compare the conducting properties of Conducto-Lube lubricant with factory lubrication and non-lubricated connections on an air switch. Identical test setups and procedures were used for each test so that comparative data could be collected and the relative performance of each type of connection could be quantified.

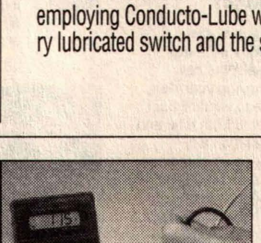
"The test results indicated that the contact resistance of the switch employing Conducto-Lube was generally lower than that of the factory lubricated switch and the switch that used no lubricant."

Cool-Amp
How it works:

- Applies *on the job*. Application is simple. Yet Cool-Amp adheres permanently. As tests show, it is better than electroplating.
- Minimizes overheating and power loss by silver plating high amperage connections.
- Saves time, reduces maintenance. Cool-Amp is so simple to apply on the job. It assures maximum conductivity for copper, brass, or bronze contacts and prevents losses due to oxidation.



A one-pound bottle of Cool-Amp silver plating powder plates approximately 6,000 square inches.



Conductivity is demonstrated by inserting test prongs into a container of Conducto-Lube and establishing a circuit. Photo shows low voltage (115 VAC) continuity through container.

Conducto-Lube
How it works:

- This is *the* conductive lubricant; highly conductive because it contains pure silver.
- Originally developed to lubricate switches, to the point tension can be adjusted to factory specs allowing full rated capacity of the switch to be maintained at all times.
- Uses have continued to expland–from switches and breakers–to any application where a conductive lubricant is needed.

*Various tests were performed on both products in the Electro-Test, Inc. facilities in Portland, Oregon during January-March, 1994. Evaluation of plating thickness of Cool-Amp was performed by Surface Science Laboratories of Mountain View, California.

COOL-AMP

Conducto-Lube

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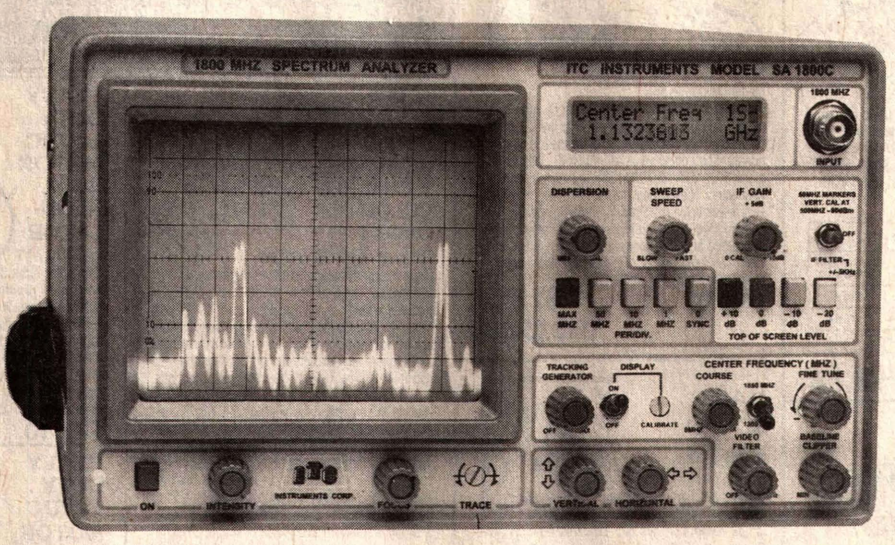
1800 MHZ SPECTRUM ANALYZER
ITC INSTRUMENTS MODEL SA 1800C
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1.1323613 GHz
1800 MHZ
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DISPERSION
SWEEP SPEED
IF GAIN
TOP OF SCREEN LEVEL
TRACKING GENERATOR
DISPLAY
CENTER FREQUENCY (MHZ)
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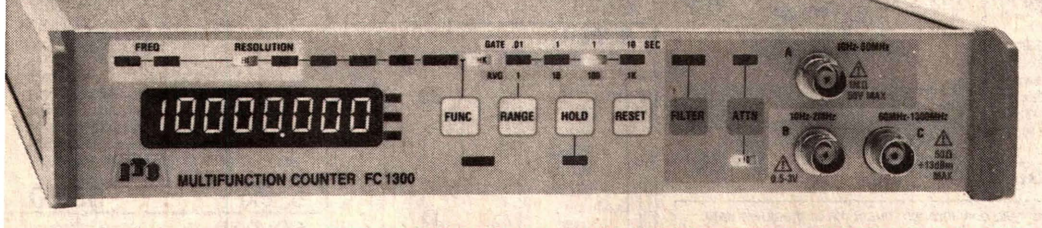
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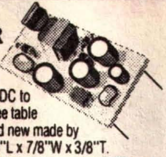
DC TO DC CONVERTER



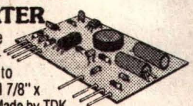
Super efficient tiny DC to DC converter converts lower voltage DC to a higher voltage DC (see table below). These are brand new made by TDK and are only 1 3/8"L x 7/8"W x 3/8"T. Very efficient and latest technology using SMD and standard technology. Power a 9V transistor radio from 1 AA battery, charge several AA batteries from one solar cell, power a 9V project using 1 or 2 AA cells, etc. Has only 4 leads (± in and ± out). With hookup diagram.

Power Table

Voltage Input DC	Voltage Output DC	Current Output
0.5VDC (solar)	3V	1mA
1.5VDC	9V	15mA
3VDC	9V	40mA

G6344 **$3.98**

TDK VOLTAGE CONVERTER



Brand new voltage converter converts 3VDC to 9VDC. Size only 1 7/8" x 1 3/16" x 1/4". Made by TDK for a major manufacturer. Output current is 60 ma at 9VDC. Use 2 penlight batteries to operate transistor radios, calculators, etc, or any electronic device that can operate on 9VDC at up to 60ma. With hookup diagram (only 3 leads are used).

G6546 **$2.00**

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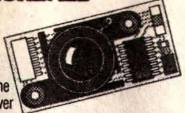
G6609 **$3.50**

TINY TRACKBALL

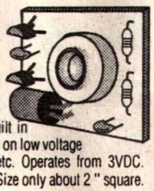
Made For A Tiny Laptop!



This is probably the tiniest trackball ever made! It measures only 1 1/16"L x 13/16"W x 3/8"H. Made by Alps for a major laptop computer maker that went out of business. They are very precision made and highest quality. The components are all SMD with an IC marked 3JA1DT002/TB6012CF and a tiny 8 position connector. They appear to be complete, new and very recent in manufacture. We have no hookup info or schematic, but at this price we know that you'll be impressed and want to experiment with them, use them for replacement or figure out the hookup! Hurry, these may not last long!

G5514 **$1.95**
10/$15.00

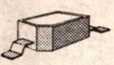
MAGIC SOUND SWITCH



Small circuit board triggers a scr from a built in microphone circuit. Turn on low voltage lamps, motors, relays etc. Operates from 3VDC. Comes with schematic. Size only about 2 " square.

G5554 **$1.00**

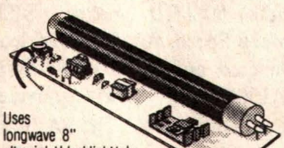
ULTRABRIGHT SMD RED LED



Very intense clear lens tiny SMD ultrabright red LED made by Panosonic. Type LN1261CAL.Prime-on tape and reel.

G6447 **4/$1.00**

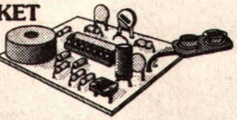
PORTABLE FILTERED BLACKLIGHT KIT



Uses longwave 8" ultraviolet blacklight tube. Operates on either 6V lantern battery or 4D cell batteries (batteries and holder not included). Skill level 2.

C6471 **$23.95**

ELECTRONIC CRICKET KIT

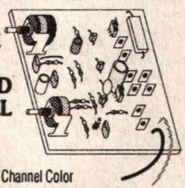


This electronic cricket starts "chirping" every time it gets dark. Of course, if you turn on the lighs to look for the "cricket" it becomes silent again. Loads of fun. Uses 9V battery (not included). Skill level 1.

C6707 **$5.30**

IF YOU CAN'T FIND WHAT YOU ARE LOOKING FOR, CALL FOR A **FREE** COPY OF OUR LATEST CATALOG. THIS CATALOG CONTAINS OUR ENTIRE PRODUCT LINE OF OVER **3,000** ITEMS AND IT IS STILL GROWING!

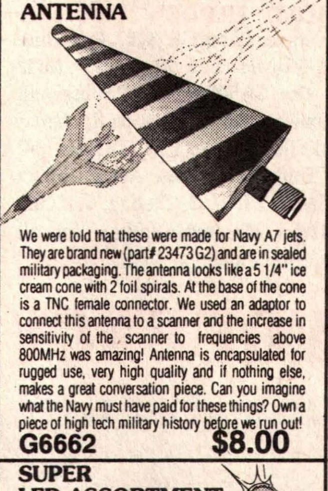
SUPER SENSITIVE SOUND ACTIVATED 2 CHANNEL COLOR ORGAN



This ultra sensitive 2 Channel Color Organ produces brilliant flashes of light (from any incandescent lamps of your choice - up to 200W) in response to music or other sounds. This is probably the best and brightest color organ we have ever seen. It is fully assembled (except for line cord and outlets) and features 2 response controls, on/off switch, sensitive FET microphone (no hookup to stereo needed) and 3 transistor, 2 SCR circuitry. Operates from standard 120VAC and requires only that you solder your line cord and 2 outlets (for your lamps) to the board. We strongly recommend that you install the color organ in an insulated case for safety reasons as it operates from the AC line. Connect up a couple of your brightest, colorful lamps and watch the fireworks with each beat of the music! Great for DJ's as there is no connection to the sound source. Size of board: 3 3/4" x 4 1/4". Color organ board only - you supply lamps, line cord, knobs, case and outlets. Hurry, these will sell very fast!

G3319 ~~WAS $5.95~~ SALE! ONLY $4.95!

A7 JET COUNTERMEASURES ANTENNA



We were told that these were made for Navy A7 jets. They are brand new (part# 23473 G2) and are in sealed military packaging. The antenna looks like a 5 1/4" ice cream cone with 2 foil spirals. At the base of the cone is a TNC female connector. We used an adaptor to connect this antenna to a scanner and the increase in sensitivity of the scanner to frequencies above 800MHz was amazing! Antenna is encapsulated for rugged use, very high quality and if nothing else, makes a great conversation piece. Can you imagine what the Navy must have paid for these things? Own a piece of high tech military history before we run out!

G6662 **$8.00**

SUPER LED ASSORTMENT

YOU GET LEDS IN THESE COLORS:

- **RED**
- **ORANGE**
- **YELLOW**
- **GREEN**

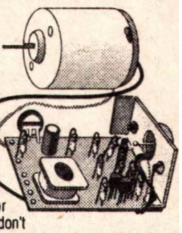
even a rare

- **BLUE!**

Assortment of all types, colors, sizes and shapes of prime high quality LEDS. This large assortment even contains a clear LED that lights up blue! Our largest and most spectacular assortment contains 250 pieces.

G6554 **$10.00**

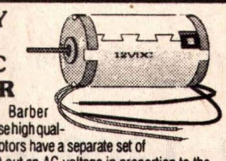
HEAVY DUTY 12VDC MOTOR WITH REGULATOR



Precision 1 7/16" Dia. motor has a 3 transistor regulator board attached. We don't have the hookup diagram on these, but they look like sophisticated electronic regulator boards. Size of board: 1 1/2" x 2 1/8". Size of motor: 1 7/16"Dia. x 1 7/8" L. The shaft is a "D" type and 1/2" long. Brand new-no other info available except that these were made by Sonar Radio Corp., part# 27-030-008.

G6540 **$1.50**

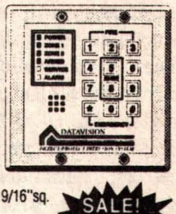
HEAVY DUTY 12VDC MOTOR



Made by Barber Coleman, these high quality 12VDC motors have a separate set of leads that put out an AC voltage in proportion to the shaft speed which can be measured on a meter. The part# is FYQM-33560-4. New, high quality with great torque. Use in robots or hundreds of other applications. Size: 1 7/8"L x 1 1/4" Dia. with 5/8" long shaft.

G6539 **$2.95**

CONTROL PANEL KEYBOARD



Keyboard with 6 LEDS and ribbon cable. Make fake alarms as this is the same unit found on the front door control panels for many professional home alarms. Size: 4 9/16"sq.

G2904 ~~WAS $3.00~~ SALE! ONLY $2.75!
10/$23.00

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We have a tremendous quantity of various items which we have too few to advertise. We have packaged a good assortment containing various semiconductors, resistors, capacitors, hardware, coils, etc. None of these items are seconds or rejects - all are factory prime and the package is really worth the price!

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G6444 **$1.00**

NOTE: All sale prices advertised are valid only through the month of the cover date.

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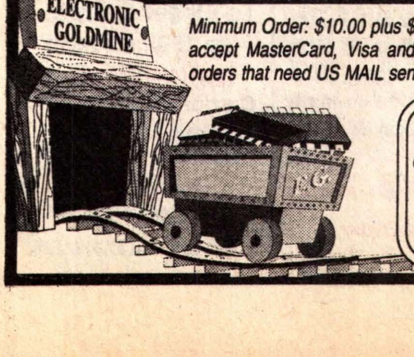

Minimum Order: $10.00 plus $4.00 Shipping and Handling. We accept MasterCard, Visa and Money orders. Canadians and orders that need US MAIL send minimum $5.00 S&H.

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"You name it, this tests it. If you maintain PC's, you'll love it."
—Jerry Pournelle,
BYTE Magazine, May 94

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MICRO-SCOPE Universal Computer Diagnostics was developed to satisfy the expanding need for accurate system diagnosis in the rapidly growing desktop computer market. Patterned after super-mini and mainframe diagnostic routines, **MICRO-SCOPE** runs independently of any standard operating system, and is therefore at home on any machine in the Intel world. Speed, ease-of-use, and razor sharp accuracy are a few of the advantages that arise from this system independence, together with an impressive list of functions including the ability to perform low level formatting on every drive currently manufactured, including all IDE drives.

◆ **LOW-LEVEL FORMAT**—Performs Low-level format on all drive types including IDE drives. This function cannot hurt IDE drives. ◆ **USE CONTROLLER BIOS**—Program will access BIOS format built into any hard disk controller—even Controllers yet to be invented. ◆ **O/S INDEPENDENT**—Does not rely on O/S for diagnostics. Talks to PC on hardware level. All tests are full function regardless of O/S (i.e. Novell, UNIX, OS/2). ◆ **TRUE HARDWARE DIAGNOSTICS**—Accurate testing of CPU, IRQ's, DMA's, memory, hard drives, floppy drives, video cards, etc. ◆ **BATCH CONTROL**—All tests, even destructive, may be selected for testing. ◆ **ERROR LOGGING**—Automatically inputs errors during testing to an error log. ◆ **AUTOMAPPING**—Automatically bad sector maps errors found on hard disks. ◆ **IRQ DISPLAY**—Show bits enabled in IRQ chip for finding cards that are software driven. (Network, Tape Backup, etc.) ◆ **IRQ CHECK**—Talks directly to hardware and shows I/O address and IRQ of devices that respond. ◆ **MEMORY EXAMINE**—Displays any physical bit of memory under 1 Meg. Very useful for determining memory conflicts. Very useful for determining available memory space. ◆ **SECTOR EDITOR**—Allows the editing of any sector of floppy or hard disk media (even track 0). ◆ **AND MUCH MORE...** We don't have enough space here for everything this software can do!

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The only Power-On Self-Test card you need to debug any "dead" PC...

"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card."
—**Scott Mueller** from his globally recognized book, ***'Upgrading & Repairing PCs, Second Edition'***

◆ Includes pads for voltmeter to attach for actual voltage testing under load. ◆ 4 LEDs monitor +5vdc -5vdc +12vdc -12vdc. ◆ Monitors Hi & Lo clock and OSC cycles to distinguish between clock chip or crystal failure. ◆ Monitors I/O Write and I/O Read to distinguish between write and read errors. ◆ Monitors memory write/ read to distinguish between address line failures and memory chip failures. ◆ Monitors ALE for proper CPU/DMA operation. ◆ Monitors Reset to determine if reset is occurring during POST, indicating short. ◆ Monitors progress of POST *without* POST codes. ◆ Reads POST codes from any IBM or compatible that emits POST codes. ISA/EISA/MCA. ◆ Compatible with Micro Channel computers. ◆ Dip switch allows easy selection of I/O ports to read. ◆ Includes tri-state **LOGIC PROBE** to determine actual chip failures. ◆ Manual includes chip layouts and detailed POST procedures for all major BIOS's. ◆ **AND MUCH MORE...**

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LIQUID CRYSTAL DISPLAYS

160 x 128 dot LCD with Built-in controller. (T6963C)

20 character x 16 line capability.

$79.00 **2 for $149.00**

Mfr: Toshiba TLX-1013-EO.
Unit is EL back-lit. Dim: 5" 1/16 L x 4" 1/16 H.
The built-in controller allows you to do text and graphics without adding an additional controller card.

Alphanumeric—parallel interface

16 x 1	3 for $25.00	**16 x 2**	$8.00
20 x 2	$12.00	**16 x 4**	$25.00
20 x 4	$25.00	**24 x 2**	$12.00
32 x 4	$20.00	**40 x 2**	2 for $25.00
40 x 4	$25.00	**4 x 2**	$5.00

5V power required • Built in C-MOS LCD driver & controller • Easy "Microprocessor" interface • 98 ASCII character generator • *Certain models are backlit, call for more info.*

Graphic and alphanumeric—serial interface

Size	Mfr.	Price
640 x 480	Epson	$50.00
640 x 400 *(backlit)*	Panasonic	$35.00
640 x 200	Toshiba	$19.00
480 x 128	Hitachi	$15.00
256 x 128	Epson	$25.00
240 x 128 *(backlit)*	Optrex	$20.00
160 x 128	Optrex	$15.00

LASER PRODUCTS

HeNe Laser Head (10Mw max. output) TEMOO, 15.5" long MFG:NEC **$99.00**
Laser Power Supply (for HeNe tube) **$100.00**

LASER SCANNER ASSEMBLY $29.00
Assembly intended for a laser printer. Includes laser diode, polygon motor (6 sided) and misc. optics and lenses.

LASER DIODE (5mW) with collimator $20.00

***LASER DIODE:* Sharp part#: LT022MC**
5mW at 780 nm, single transverse mode **$10.00**

NETWORK

IRMA BOARD 8 bit $99.00
Links 3270 mainframe systems to IBM PC

Proteon ProNet-4 Model p1347 Token Ring Board $79.00
16 bit • 4 Mbps • IEEE 802.2 and 802.5 compatible • twisted pair • interoperable with IBM Token Ring network

POS & BAR CODE

MAGNETIC CARD READER $25.00
Includes: • 20 character dot matrix display with full alpha-numeric capability • keypanel with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBCS 2300)..................$35.00

POWER SUPPLYS

73 WATT SWITCHING $15.00 or 2 @ $25.00, (2) 4 pin power connectors attached • 115/230 Volt, Dim: 8.5" L x 4.5" W x 2" H • Output: +5V @ 2-9.75 A, +12V @ 0-1.5 A, -5V @ 0-0.4 A, -12V @ 0-0.5 A

68 WATT SWITCHING $12.00 or 2 for $20.00, 115/230 Volt, Dim: 5.5" L x 3.2" W x 1.7" H • Output: 5V @ 4 A, 12V @ 4A

MISCELLANEOUS

ADAPTEC 4070A (RLL) OR 4000A (MFM) SCSI Controller, your choice $40.00

IBM 370 option XT and AT emulation boards $50.00

MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input.
Horizontal frequency 15Khz.
Ability to do 40 and 80 column.

5 inch Black & White	**$35.00**
7 inch Amber	**$39.00**
9 inch Amber	**$29.95**
12" Green or B/W	**$19.95**

Enclosed

9" Green BNC composite 115V/230V	$69.00
12" White BNC composite 24V	$79.00

Mfr.: Electrhome • For Very High Quality Medical & Industrial Applications

5" COLOR MONITOR $69.00

2 for $109.00

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector
- Degaussing Coil Included • *Mfg.: Samtron*

CHARGE COUPLED DEVICES

MATRIX TYPE

"The Spy In The Sky" $49.00

Sony CCD Imager - designed for black and white composite video cameras. Picture elements: 384 (H) x 491 (V)

Chip size 10.7 (H) x 9.3 (V) mm^2 • Unit cell size 23.0 (H) x 13.4 (V) um^2 • Ceramic 24 pin DIP package. • Mfr: Sony, Part# 016AL

LINEAR TYPE

4096 element CCD $29.00
2048 element CCD $15.00 • 1728 element CCD $15.00

HACKER CORNER

CELL SITE TRANSCEIVER $99.00

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030–889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions are available.

Proxim — Spread Spectrum RF Modem $99.00

The Proxlink is a small communication device that replaces the use of an RS-232 cable hook-up with wireless (Radio Frequency) technology. Each module combines the functions of an RS-232 compatible modem (or any other RS-232 device) and a transmitter/receiver operating in the 902-928 MHz band. Indoor range of up to 500 feet possible using standard 1/4 wave antenna. Units support data rates up to 19.2 KBaud (full duplex) and use multiple channels to allow for non-interfering overlapping systems. Message format is 8 data bits, no parity, and 1 stop bit. Each unit requires 5 VDC supply at a maximum of 230 mA. A wide variety of configurations can be accommodated with parameters stored in non-volatile memory (EEPROM). Configuration changes are supported by menu driven, on-board software. Installation schematics and application details are available. Original cost on these units is around $600.

Portable Micro Terminal

Flip up LCD display (9-16 VDC) • Can communicate with any computer having RS 232 port • Can communicate with another Microterminal • Use by itself as electronic notebook • Onboard microprocessor, data RAM (32K) and Video RAM (64K) • Complex built in diagnostics and set up capabilities. • Original intention for POS applications. • display size 40x16 (256 x 128 pixels.) Dimensions: 6.3" W, 11"L, 2"H. (With LCD up height is 7.1")

$99.00 **or 2 for $149.00**

All in one 286 board $29.00

Includes: • 286-12Mhz CPU (1 wait state) • Built in IDE & floppy controller • 80287 math coprocessor socket • FAST! on board SVGA with 256K RAM • 2 serial ports, 1 printer port, mouse port • EMS-LIM ver 4.0 memory & shadow RAM support • Up to 8 mb memory (256K or 1 Mb SIMMS) • Comes with 0K on board • On board speaker • REAL TIME CLOCK • Phoenix BIOS • Note: There is one long non standard bus connector on board

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Xplor **P**ersonal **D**igital **C**ontrollers can propel you into the wide open frontier of computerized control and monitoring with minimal effort and cost. No mere novelty, these "mini-sports" pack surprising power and are loaded with extras that make the journey from idea to working reality fun and rewarding.

Professionals will find Xplor PDCs an efficient, economical way to add simple, yet reliable control capabilities to prototypes or full-scale production runs. Beginners and hobbyists can use PDCs to sharpen their programming skills while developing original concepts. Just identify a need and hit the accelerator – Embedded Control, Simple Robotics, PC Peripherals, Monitoring Systems, Data Logging – Xplor PDCs will take you to the far reaches of your imagination.

XPLOR™
32c
$89.95

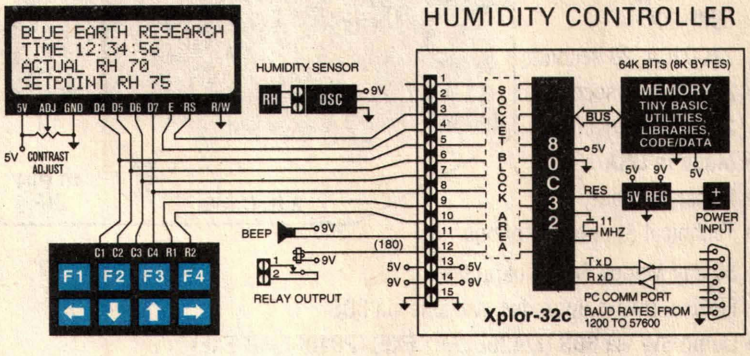
- 80C32 CPU with 12 digital I/O lines
- 64K bit EEPROM for program/data storage
- I/O socket block for transistors, resistors, etc.
- Screw terminal block and project case.

Also available with 11 channel 10-bit A/D converter – Xplor-32ca

Built-in BASIC Language, Powerful Utilities, and Library Functions Make Programming Easy

The example below shows how easy it is to wire-up and program the Xplor-32c for a simple on/off controller application. The built-in software gives you the power to write programs like this in just minutes. Your program is stored in nonvolatile memory and will automatically execute when power is applied.

HUMIDITY CONTROLLER

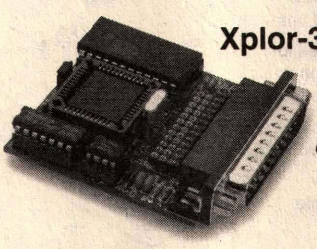

BLUE EARTH RESEARCH
TIME 12:34:56
ACTUAL RH 70
SETPOINT RH 75
5V ADJ GND D4 D5 D6 D7 E RS R/W
5V CONTRAST ADJUST
HUMIDITY SENSOR
RH
OSC
9V
C1 C2 C3 C4 R1 R2
F1 F2 F3 F4
BEEP
9V
(180)
RELAY OUTPUT
5V
9V
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
SOCKET BLOCK AREA
8 0 C 3 2
64K BITS (8K BYTES)
MEMORY
TINY BASIC, UTILITIES, LIBRARIES, CODE/DATA
BUS
5V REG
RES
11 MHZ
POWER INPUT
TxD
RxD
PC COMM PORT
BAUD RATES FROM 1200 TO 57600
Xplor-32c

ALL YOU NEED IS A PC and a Terminal Program
(Or Xplor Starter Package)

No Other Programming Equipment Required!

```
10   CALL 8132                             (LIBRARY FUNC: Initialize LCD)
20   ONTIME 200                            (Initialize 1 second interrupt)
30   PRINT "BLUE EARTH RESEARCH" ;         (Display sign-on message)

40   PRINT  " \\ ACTUAL RH " ; FREQ  0 ;   (Display actual sensor frequency)
50   PRINT " \\\ SETPOINT RH " ; S ;       (Display desired setpoint value)

60   CALL 8140                             (LIBRARY FUNC: Get keypad input)
70   IF DBY 27=6 THEN S=S - 1              (Decrement setpoint if down arrow)
80   IF DBY 27=7 THEN S=S + 1              (Increment setpoint if up arrow)

100  IF FREQ 0<S THEN BIT 180=1            (If actual < setpoint then relay on)
110  IF FREQ 0>S THEN BIT 180=0            (If actual > setpoint then relay off)
120  GOTO 40                               (Loop back to repeat program)

200  PRINT " \TIME " ; DBY 51 ; " : " ;    (This 1 second interrupt routine)
210  PRINT DBY 50; " : " ; DBY 49 ;  : IRET ( refreshes LCD with current time. )
```

Xplor PDCs – MORE CHOICES FOR GREATER FLEXIBILITY



Xplor-32 $59.95

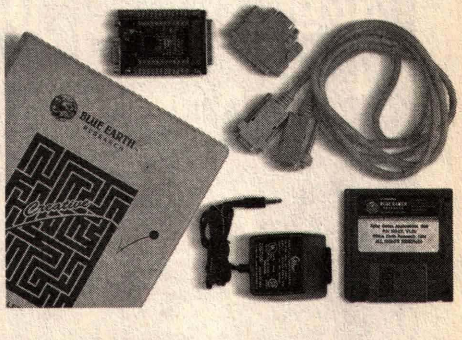
Same features as the 32c less case and terminal block. Board is only 2.15" x 2.2".

Xplor-32a $79.95
with 11 channel 10-bit A/D converter.

Xplor-32d $79.95
with 24 extra digital I/O lines.

Complete Packages from $99.95

All Xplor PDCs are available in starter packages that include the Xplor board, screw terminal blocks, RS-232 cable, 9V power supply, users manual, application notes, and MSDOS format disk. The disk includes sample BASIC programs, library source code, BXA-51 and TB-QComm. The BXA-51 assembler can be used for making library changes or other assembly language programming. TB-QComm is a communications utility that allows you to load HEX files and load, edit, or save BASIC programs.


BLUE EARTH RESEARCH
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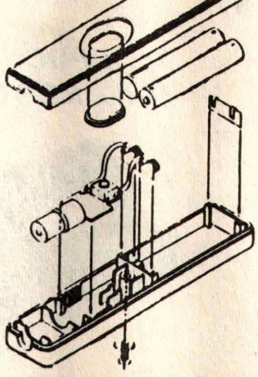

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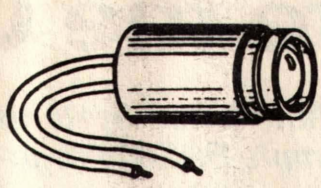

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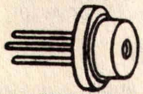

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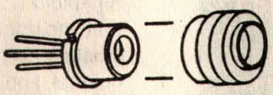

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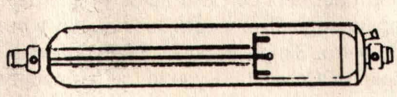

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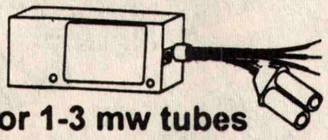

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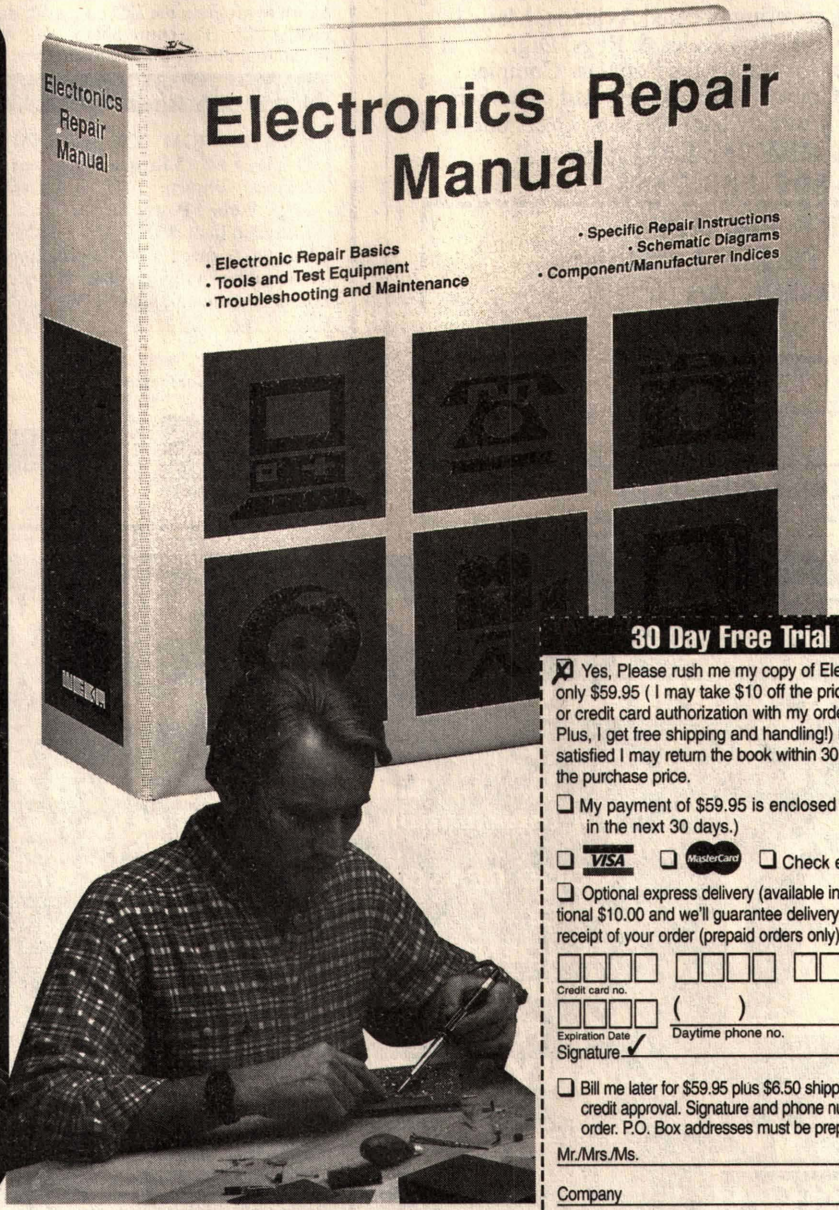
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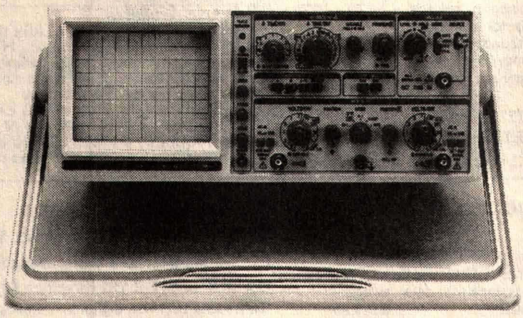

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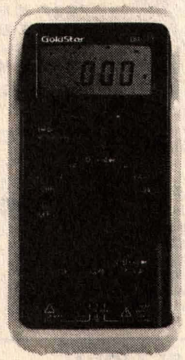

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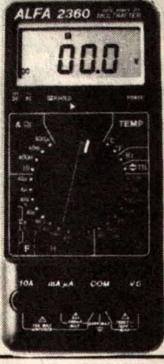

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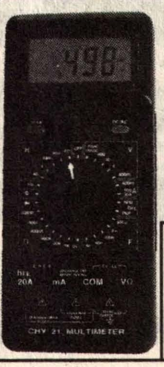

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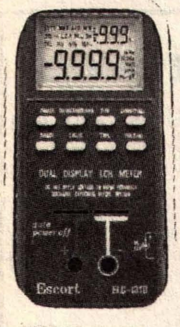

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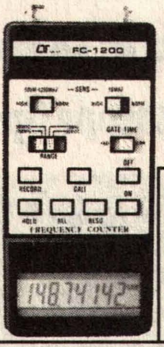

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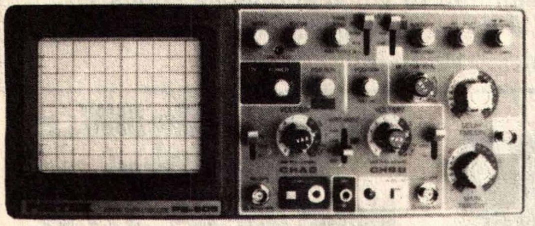

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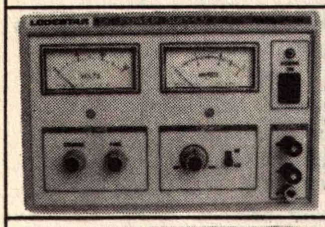

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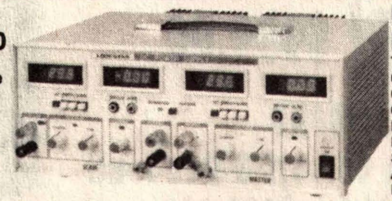

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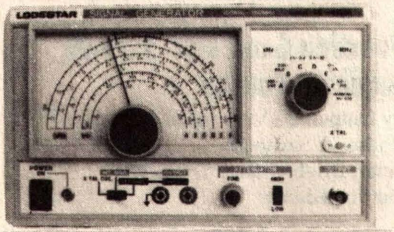

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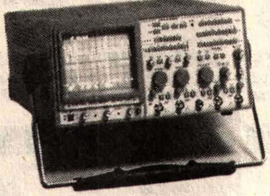

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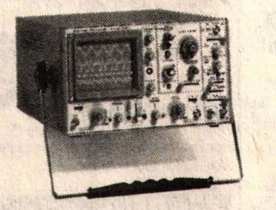

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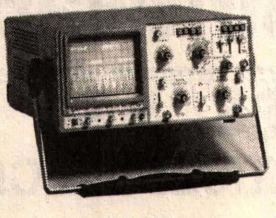

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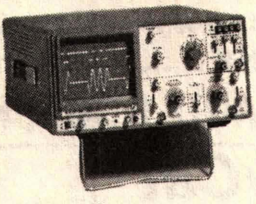
0 MHz Oscilloscope
S-622B $344.95



Dual trace, X-Y operation
TV Sync., Z-axis input,CH 1 output
High sensitivity 1 mV/div
Trigger level lock
2 probes (x1, x10)

S-645B - 40 MHz Cursor readout	$ 734.95
S-625B - 20 MHz Cursor readout	$ 549.95
S-623B - 20 MHz w/Delayed Sweep	$ 449.95
S-935 - 5 MHz One channel	$ 209.95

DC Linear Power Supplies Single Output

- * Constant voltage and constant current mode
- * Voltage regulation ≤0.01%
- * Current regulation ≤0.2%
- * Low ripple and noise
- * Overload and reverse polarity protection
- * Features 2 analog or 1 digital meter(PS series)
  2 analog or 2 digital meters(PR series)

PS-1830	(0-18V, 0-3A)	$209.95
PS-1830D	Digital Display	$219.95
PS-1850	(0-18V, 0-5A)	$219.95
PS-1850D	Digital Display	$244.95
PS-3030	(0-30V, 0-3A)	$224.95
PS-3030D	Digital display	$254.95
PS-6010	(0-60V, 0-1A)	$209.95
PR-1810H	(0-18V, 0-10A)	$349.95
PR-3060	(0-30V, 0-6A)	$314.95
PR-6030	(0-60V, 0-3A)	$299.95
PR-6030D	Digital Display	$399.95

Triple Output DC Power Supplies

- * Two variable 0-30VDC, 0-3A outputs
- * One fixed 5VDC, 3A output
- * Auto tracking
- * Auto serial and parallel operation
- * Constant voltage and constant current mode
- * Continuous/dynamic load can be selected
- * Features 4 analog or 2 digital displays

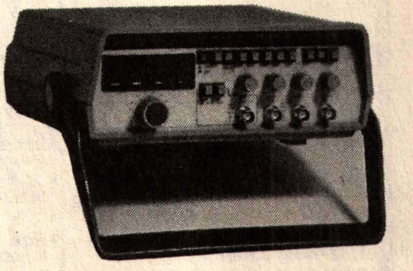
PC-3030	(0-30V, 0-3Ax2)	$499.95
PC-3030D	Digital display	$549.95

Programmable DC Power Supplies

- * High stability , low drift, 4 digit display
- * Front/rear output-sense switch selectable
- * Auto step running w/timer settings
- * 100 point programmability (PPS series)
- * 50 point programmability (PPT series)
- * Auto serial and parallel operation (PPT series)
- * Auto tracking (PPT series), IEEE-488.2 and SCPI compatible command set (optional)

PPS-1860G	(0-18V, 0-6A)	$1099.95
PPS-3635G	(0-36V. 0-3.5A)	$1099.95
PPS-6020G	(0-60V, 0-2A)	$1099.95
PPT-1830G	(0-18V, 0-3Ax2, 0-6V, 0-5A)	$1399.95
PPT-3615G	(0-36V, 0-1.5Ax2, 0-6V, 0-3A)	$1399.95

Digital Display Function Generator FG-8016G $239.95



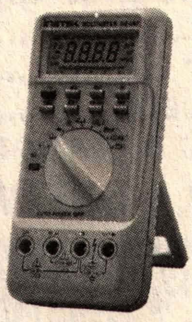
- * Frequency Range: 0.02Hz to 2MHz
- * Three Instruments in one: Function generator, Pulse generator & Frequency counter.
- * Sine, Triangle, Square, TTL Pulse and CMOS output
- * Built-in 6 digit counter with INT/EXT function
- * 1000:1 tuning range
- * Variable DC offset control

FG-8015 Function Generator	
* 0.02Hz-2MHz (No Counter)	$189.95
FC-8131 Intelligent Counter 1.3GHz	$469.95
FC-8270 Intelligent Counter 2.7GHz	$629.95
UC-2010G Universal Counter	$294.95

Digital Multimeter & C Meter
DM-8034(3½ digits) $179.95

- * 8 Function, AC/DC voltage, AC/DC current, resistance
- * Built-in C meter, diode test and audible continuity check
- * High voltage 1000V and 20A range
- * 0.5% basic accuracy

DM-8040 (3¾ Digits, True RMS)	
* Measures ACV to 50 kHz	$339.95
DM-8055 (5½ Digits)	$649.95
* 0.006% basic accuracy * 1μV, 1mΩ, 1nA resolution * dBm measurement * Auto range, relative mode, Max/Min	
DM-8055G(5½ Digits, GPIB)	$889.95



Model DM-392
(3¾ digits) $109.95

- * Auto/Manual ranging(38 ranges)
- * 42 Segment analog bar graph
- * Data Hold/Min-Max memory /Relative mode
- * Auto power off
- * Overload protection
- * Audible continuity check /diode test
- * Capacitance: 1pF-40μF
- * Frequency: 0.1Hz-1MHz
- * 20 Amp range
- * Double high energy fused (1A, 20A)
- * 0.3% DCV accuracy
- * **AC True RMS** (DM-394 only)

DM-351	3½ Digits w/Continuity, Auto Off	$54.95
DM-352	3½ Digits, Cap. Freq. hFE, 20 Amp	$79.95
DM-353	3½ Digits, Cap. Freq. Temp. hFE	$84.95
DM-391	3¾ Digits, Auto, Cap. Freq. Min/Max	$99.95
DM-392	3¾ Digits, Hold, Min/Max 20Amp	$109.95
DM-393	3¾ Digits, Peak, Logic, hFE, Freq	$119.95
DM-394	3¾ Digits, TRMS, Same as DM 392	$129.95

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- Tunes 88-108 MHz.
- Powerful 2 stage audio amplifier.
- Sensitive, picks up sounds at the level of a whisper.
- Up to 1 mile range.
- Requires 9V battery. (Not incl.)

SUPER-MINIATURE FM TRANSMITTER

Super small FM transmitter. Use with any FM broadcast receiver. Easy to assemble, all chip (SMT) parts are pre-assembled to the circuit board.

XST500 (E-Z) Kit $44.95

- Miniature photo battery mounts right on circuit board. (Included)
- Tunes 88-108 MHz.
- Up to 1/2 mile range.
- Sensitive 2 stage audio amplifier, picks up sounds at the level of a whisper..

MICRO-MINIATURE FM TRANSMITTER

Including the battery, this is the Worlds smallest FM transmitter. Use with any FM broadcast receiver. Easy to assemble, uses pre-assembled circuit board.

XWB1000 E-Z KIT $49.95

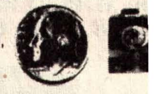
- Transmits at 143 MHz.
- Up to 1 mile range.
- Miniature photo battery mounts right on circuit board. (Included)
- Amazing audio sensitivity, picks up sounds at the level of a whisper.

CRYSTAL CONTROLLED FM TRANSMITTER

Including the battery, this is the Worlds smallest crystal controlled FM transmitter. Transmits to any scanner type receiver. Easy to assemble, uses pre-assembled circuit board.

XTL1000 E-Z KIT $69.95

- Smallest Phone transmitter anywhere!
- Tunes 88-108 MHz.
- No batteries required, powered by phone line.
- Up to 1/4 mile range.
- Attach to phone line anywhere in house, even inside phone.



SUPER-MINIATURE PHONE TRANSMITTER

Worlds smallest FM phone transmitter. Use with any F broadcast receiver. Easy to assemble, all chip componer are pre-assembled to the circuit board.

XSP250 (E-Z) Kit $34.95

- Dial your phone from anywhere and listen to the sounds inside your home.
- Two digit Touch Tone code for secure operation.

TELEPHONE SNOOP

The latest in home or office security. Call home from anywhere, enter a two digit security code, and hear the sounds in your home. Automatically turns on without ringing the phone, verifies code, then activates for one and a half minutes.

XPS-CASE KIT $13.95

XPS1000 (C) KIT $49.95

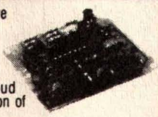
- Transmits a continuous beeping tone.
- Adjustable from 88 to 108 MHz.
- Up to 1 mile range.
- Works with any FM broadcast receiver.

TRACKING TRANSMITTER

Only 0.7 by 2.4 inches, the XTR100 operates at voltages of 3 to 18 Volts and is ideal for use in locating lost model rockets, bicycles, automobiles, games of hide and seek, and contests.

XTR100 (C) Kit $33.95

- Uses sensitive microwave transistor amplifier.
- Covers 1 to 2,000 MHz.
- Compact hand held unit.
- Includes miniature loud speaker for audio indication of detected signals.



SUPER SENSITIVE BUG DETECTOR

When the XBD200 intercepts a signal in the 1 to 2,000 MHz range, it emits a growl that increases to a high pitched squeal as the signal strength increases.

XBD200 (C) Kit $49.95

- Use with any FM broadcast receiver.
- Hear every sound in an entire house!
- Up to 1 mile range
- Powerful 2 stage audio amplifier.

MINIATURE FM TRANSMITTER

The XFM100 has a super sensitive microphone and capable of picking up sounds at the level of a whisp and transmitting them to any FM broadcast receiver.

XFM100 (C) Kit $32.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Anonymity on any call.
- Button for normal operation.
- 16 levels of voice masking.

VOICE CHANGING TELEPHONE

STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Single phone operation only.

TRANSITION 2000 .... $89.95

- Digital voice changing: male to female, female to male, adult to child, child to adult.
- Use with any modular phone.
- 16 levels of voice masking.
- Connects between handset and phone.

VOICE CHANGING ACCESSORY

STOP THOSE ANNOYING TELEPHONE CALLS! Sound older and tougher when you want to. Not a kit. Fully assembled. Use with single or multi-line phones.

TRANSITION 2001 .... $59.95

- Uninterrupted coverage of 800 to 950 MHz.
- Works with any scanner that can receive 400 to 550 MHz.

800-950 MHz SCANNER CONVERTER KIT

If your scanner can receive 400-550 MHz, just add the XLC900 for uninterrupted 800-950 MHz coverage. It converts all 800-950 MHz signals down to 400-550 MHz so your scanner can receive them! Add our custom case kit for that "Professional" look.

XLC-CASE KIT $13.95

XLC900 (C) KIT $49.95

- Transmit high quality stereo to any FM stereo receiver.
- Built-in output level monitor for quick and easy tuning.
- Ideal for use with personal CD player.

FM STEREO TRANSMITTER

Transmit full-bodied Hi Fi stereo to any FM stereo receiv Separate left and right inputs and gain controls. Includes output booster stage for greater range.

XFS-CASE KIT $13.95

XFS108 (C) KIT $41.95

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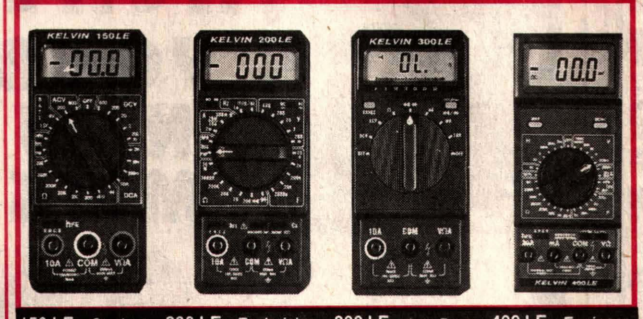
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KELVIN 300LE
KELVIN 400LE

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TRANSISTOR BATTERY TEST DC CURRENT 10 Amp	FREQ COUNTER up to 20MHz CAPACITANCE from 1pF to 20uF TRANSISTOR AC/DC CURRENT 10 Amp	AUTO RANGE with 3200 counts AC CURRENT DC CURRENT ANALOG BAR 10 Amp	INDUCTANCE Resolution 1uH FREQ COUNTER up to 20MHz CAPACITANCE from 1pF to 200uF AC/DC CURRENT TRANSISTOR DUTY % 20 Amp
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$29.95	$49.95	$49.95	$79.95

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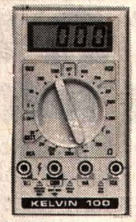
990087 **$19.95**



- AC & DC VOLTAGES
- DC CURRENT
- RESISTANCE
- 3 1/2 Digit LCD
- CONTINUITY TEST
- -Buzzer
- LOW BATTERY INDICATOR
- DIODE TEST ● BATTERY TEST

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KELVIN
250 LE
990126 **$59.95**

- 0.5% ACCURACY
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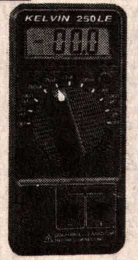
KELVIN 250LE

Designed to meet IEC-348 & UL-1244 safety specifications.

Protective Cases

For Models 100 Basic, 150LE, 200LE, 300LE .... $4.95 (#990088)

Case For Model 400LE .... $9.95 (#990116)

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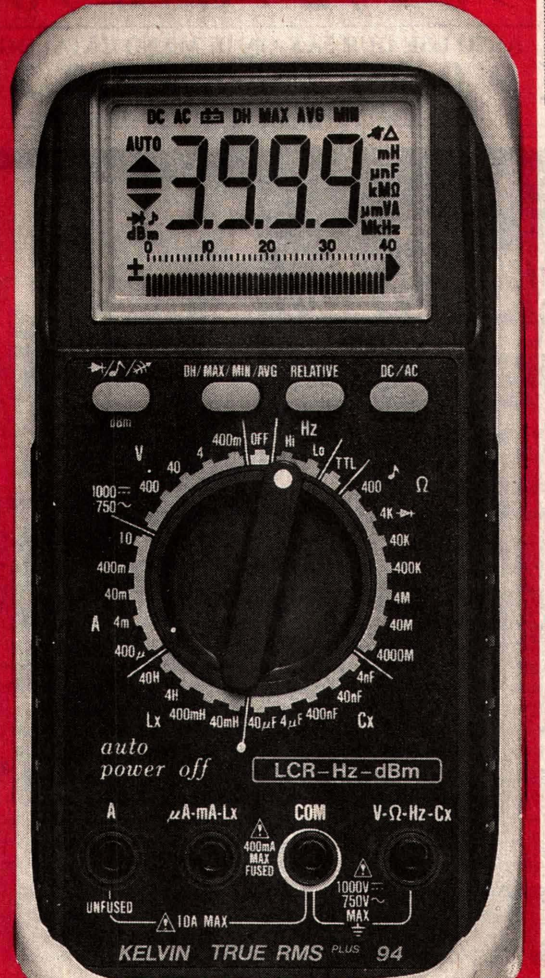
DC AC DH MAX AVG MIN
AUTO
3.9.9.9
mH μnF kMΩ μmVA MkHz
dBm
0 10 20 30 40
DH/MAX/MIN/AVG
RELATIVE
DC/AC
dBm
V
A
Hz
Lx
Cx
Ω
auto power off
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Freq Counter to 20 MHz

***Protective* Cases for Model 94**

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1,000s of PBXs are hacked to the tune of **$** Billions/yr! While **"VOICE MAIL HACKING"** details how VMSs are hacked for "phun" and profit - including VMS methods for hacking PBXs themselves - **"PBX HACKING"** addresses ALL issues relating to PBX hacking, including countermeasures! Can your business or agency afford a $90,000 phone fraud loss (the average loss due to hacked PBXs)? As described in **Forbes Magazine. $29**

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Dozens phone color boxes described - many circuits. Plus **Call Forwarding, Conferencing, Phreak History, Glossary, Diverters, Extenders, Loops, REMOBS, Bridging Heads & Cans, Optocom, 3rd Party** and many other non-box methods - more. **$39.**

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COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how **VIRUSES, TROJAN HORSES, WORMS,** etc are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary **FLU-SHOT+** protection system (**Ed. Choice, PC Magazine**). BBS advice, password defeats, glossary - much more! **Manual + Disks* $39.**

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As reported on **CBS "60 Minutes": How certain devices can slow down - even stop - watthour meters - while loads draw full power!** Device simply plugs into one outlet and normal loads into other outlets. Also describes meter creep, overload droop, etc. Plans **$29. I.G. MANUAL:** External magnetic ways (applied to the meter itself) to slow down and stop watthour meters while drawing full loads. Plans. **$19. KW-HR METERS:** How watthour meters work, calibration, error modes (many), ANSI Standards, etc. **Demand** and **Polyphase Meters.** Experimental results to slow and stop meters by others. **$19.** Any 2, **$38.** All 3, **$59.**

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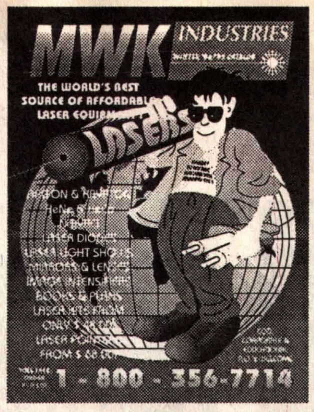

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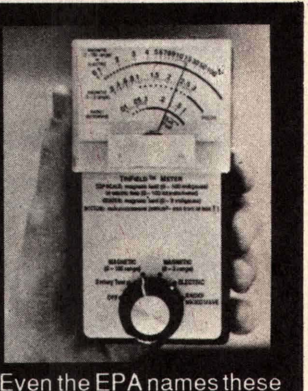

Most homes and offices have hot spots with strong artificial electro-magnetic fields, where chronic exposure may cause mental or physical problems. Even the EPA names these fields as suspected carcinogens. You can reduce your risk by avoiding these high-field areas.

The ***TriField***™ meter detects *far more* of these fields than any other electromagnetic pollution meter. It's the only one that independently reads AC electric fields, AC magnetic fields, *and* radio/microwaves. It also reads field strengths in *all directions simultaneously*. Every other meter that sells for under $500 reads only magnetic and only in one direction — they can entirely miss a magnetic field unless pointed correctly and are blind to radio/microwaves and electric fields, both of which cause biological effects.

The ***TriField***™ meter reads all three types of fields numerically and with a SAFE/BORDERLINE/HIGH SCALE, weighted proportional to effect on the body. Thresholds are based on epidemiological and laboratory studies. (While no *absolute* hazard thresholds have been established, reduction of *relative* exposure is prudent.)

The ***TriField***™ meter comes ready-to-use with battery, instructions, and one-year limited warranty. The cost is $144.50 postpaid.

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VIDEO NEWS

continued from page 6

substitute for the VCR, because it won't record. There was talk, however, of a recordable version in 1998 or 1999, when blue lasers are in mass production.

One of the most intriguing features of the DVD—presumably both the Toshiba and the Sony versions—is its extreme flexibility, allowing a single disc to suffice for many purposes, thereby reducing dealers' inventory requirements. Multiple soundtracks on a single disc can appeal to various language groups in a single country or in several countries. The same disc can satisfy different types of TV receivers and viewing preferences, supply a letterboxed picture (for viewing on a standard set with black bands above and below), a full-resolution 16:9 picture (for viewing on a widescreen set), or a standard 4:3 pan-and-scan version. By the same token, a single movie can be viewed in the original theatrical release version, or in an abridged version with the "adult" scenes eliminated to protect kiddie viewers.

The Sony-Philips reaction to the Toshiba-Time Warner announcements and demonstrations was rather confusing. While publicly favoring a single standard to avoid a repetition of the Beta/VHS standards war, Sony first announced that it planned to go ahead with its system anyway. Later, it hinted that it was open to talks with the rival camp, possibly to develop a compromise version. However, at our press time, no formal talks were going on.

Although the odds now appear to favor the Toshiba-Time Warner proposal, a compromise—or even a reversal—can't be ruled out at this time.

No matter which side wins, or if the two systems are combined into a single one, we should have a new—and superior—home video system in a year or so. Ω

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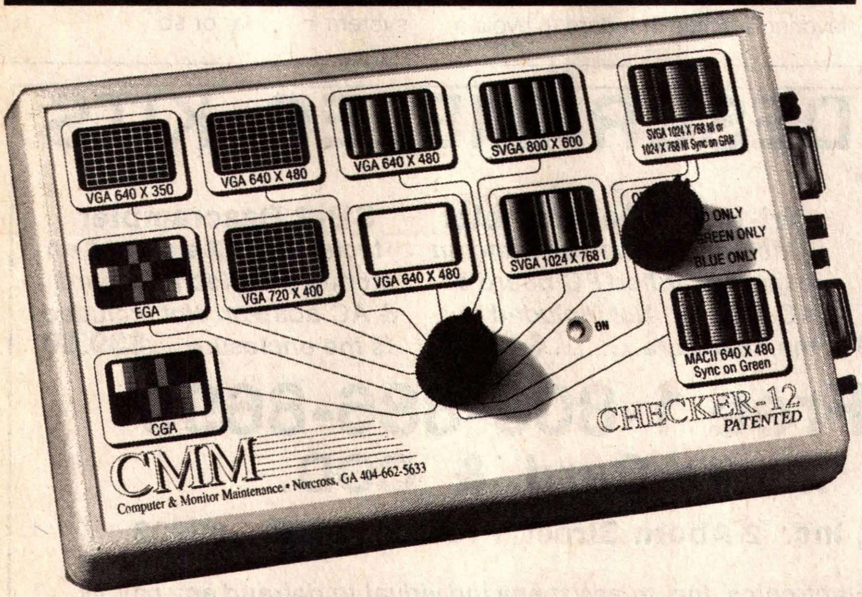

The "Checker 12" is a hand held, battery/AC operated computer color monitor pattern generator.

The "Checker 12" fills a need in both the field service and shop maintenance areas. With the "Checker 12", a field service technician can quickly isolate display problems without having to open the computer. By simply connecting the monitor to the "Checker 12", most problems can be quickly isolated. No more swapping video cards or monitors. In the shop, no longer will you need to search for the correct video card, or tie up a computer system to test or burn in a monitor. With its support of CGA, EGA, MACII, and VGA modes 1,2,3, 300x600, 1024x768NI, 1024x768NI with sync on Green, you can easily checkout a monitor in all of its modes.

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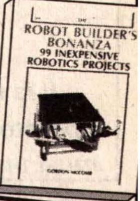

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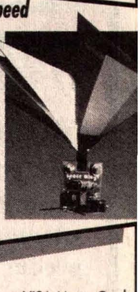

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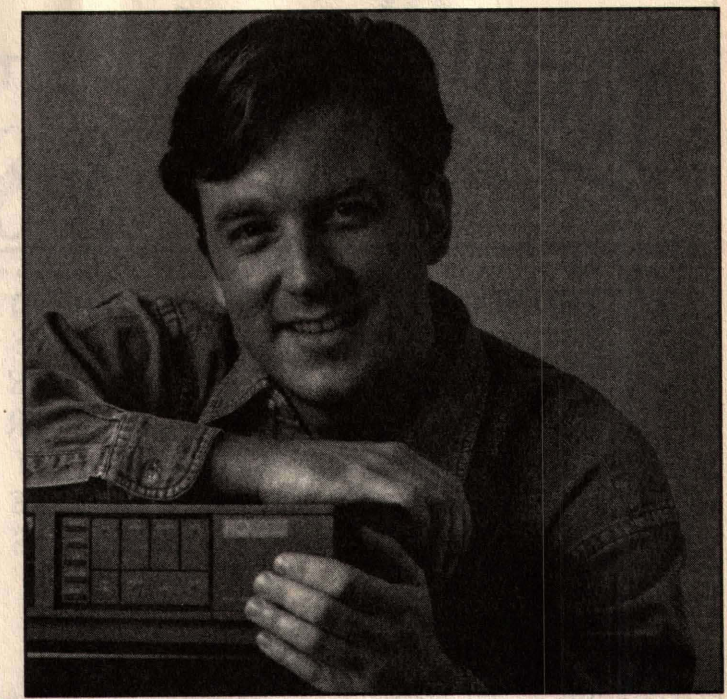

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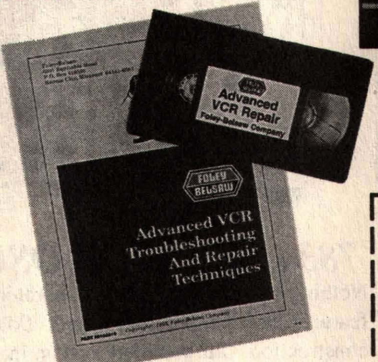

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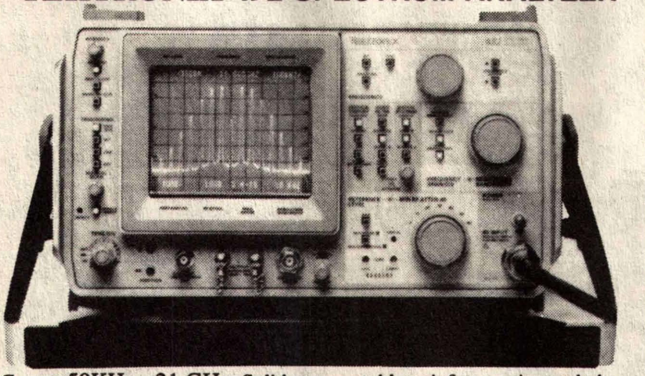

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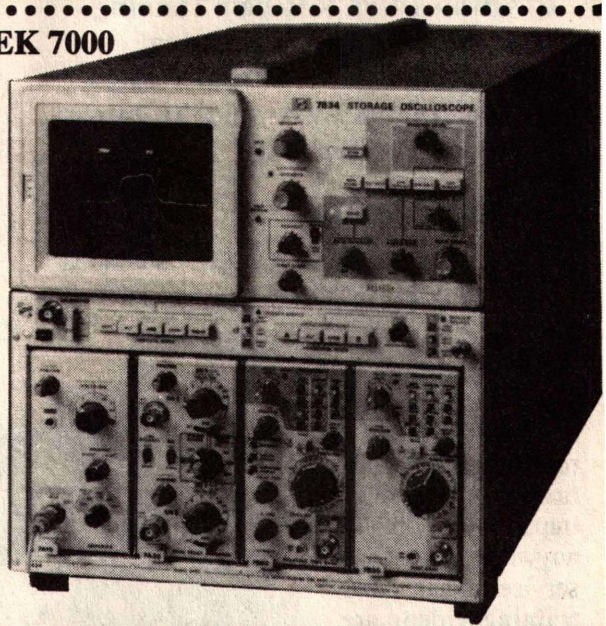

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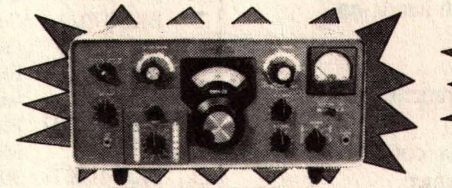

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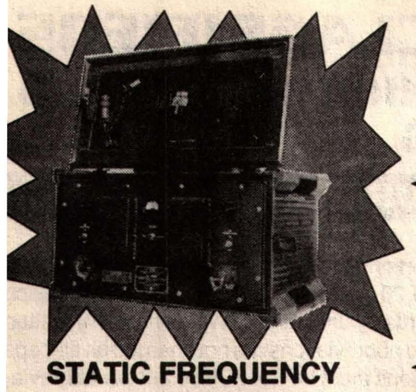

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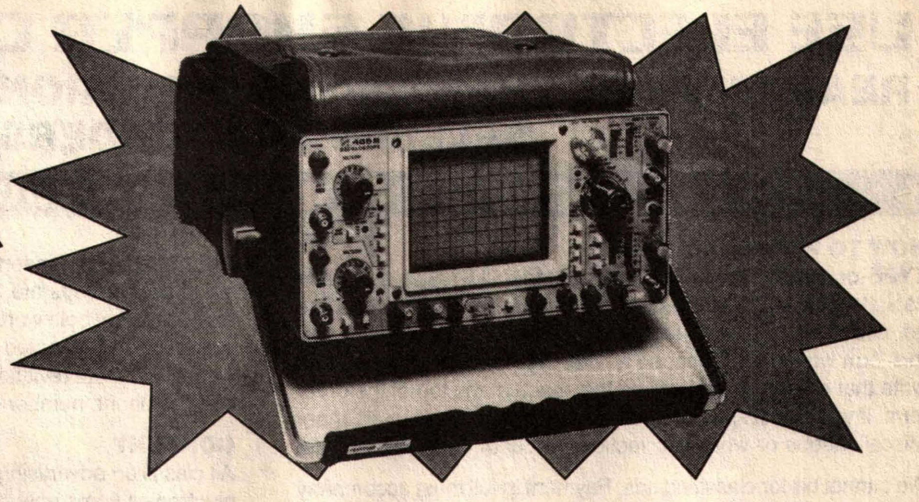

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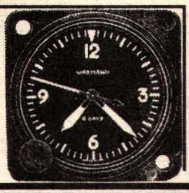

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-GOULD 220 CHART RECORDER	$ 950.00
-GOULD RS 3800 PROGRAMABLE CHART RECORDER/w MOD 5900 SIG CONDITIONER &DC AMPS (NEW)	$6,500.00
-IFI MOD 404 WIDEBAND LABORATORY POWER AMP - .01-250MHz @ 2.5Kw POWER OUTPUT	$ CALL
-MARCONI MOD 2019 SYNTHESIZER 1024MHz	$2,800.00
-ROHDE & SCHWARZ SIG GENERATOR .4-484MHz	$ 500.00
-SOUND TECHNOLOGIES DIS MEAS SYSTEM	$1,200.00
-SCHENCK DYNAMIC BALANCING MACHINE MOD CAB570 WITH- BED , SENSORS & MANUAL	$4,500.00
-WILTRON 6647A-40 PROG. SWEEP GEN. 10MHz-18.6GHz	$8,500.00

- ANRITSU MS420K NETWK SPEC- AN.10Hz-30MHz	$1,800.00
- EATON NM-17/27A EMI FIELD INT. METER	$1,500.00
- FLUKE 5100A CALIBRATOR	$3,800.00
- FLUKE 6039A FREQUENCY SYNTHESIZER	$ 500.00
- WAVETEK 3002 RF SIG. GENERATOR	$ 795.00
- BOONTON 82AD AM/FM MOD-METER	$1,275.00
BOONTON 102F SIG. GEN. 1040MHz	$1,295.00
- COLLINS 516-F2 PWR SUPPLY(USED)	$ 85.00
- COLLINS 651S-1 RECEIVER	$1,250.00
- R392 RECEIVER .5-30MHz	$ 165.00
- T195 100w COMPANION XMTR TO 392	$ 85.00
- GRT-22 UHF POWER AMPLIFER	$ 200.00
- HARRIS RF280 HF/TACTICAL TRANSCEIVER	$1,500.00
- LEXEL MOD 75 HIGH POWER ARGON LASER	$1,500.00
- HP 8640A SIGNAL GENERATOR (512MHz)	$ 995.00

may 95

CIRCLE 330 ON FREE INFORMATION CARD

USE ELECTRONIC SHOPPER CLASSIFIEDS

READ BY MORE THAN 100,000 ELECTRONICS BUYERS AND SELLERS AND TRADERS

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.25 per word. Minimum charge is $18.75 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **Electronic Shopper** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by April 1 will appear in the July,1995 issue that is on sale in June 1. Shopper ads will appear Jan., Mar., May etc. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

AD RATES: $1.25 per word, Minimum $18.75.

Send your ads with payment to:
Electronic SHOPPER, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics
130 — Audio-Video-Lasers
160 — Business Opportunities
190 — Cable TV
210 — CB-Scanners
240 — Components
270 — Computer Equipment Wanted
300 — Computer Hardware
330 — Computer Software
360 — Education
390 — FAX
420 — Ham Gear For Sale
450 — Ham Gear Wanted
480 — Miscellaneous Electronics For Sale
510 — Miscellaneous Electronics Wanted
540 — Music & Accessories
570 — Plans-Kits-Schematics
600 — Publications
630 — Repairs-Services
660 — Satellite Equipment
690 — Security
710 — Telephone
720 — Test Equipment

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # ______

1 - $18.75	2 - $18.75	3 - $18.75	4 - $18.75
5 - $18.75	6 - $18.75	7 - $18.75	8 - $18.75
9 - $18.75	10 - $18.75	11 - $18.75	12 - $18.75
13 - $18.75	14 - $18.75	15 - $18.75	16 - $20.00
17 - $21.25	18 - $22.50	19 - $23.75	20 - $25.00
21 - $26.25	22 - $27.50	23 - $28.75	24 - $30.00
25 - $31.25	26 - $32.50	27 - $33.75	28 - $35.00

Total classified ad Payment $ ______ enclosed.

[ ] Check [ ] Mastercard [ ] Visa ($18.75 minimum credit card order)

29 - $36.25	30 - $37.50	31 - $38.75	32 - $40.00
33 - $41.25	34 - $42.50	35 - $43.75	36 - $45.00
37 - $46.25	38 - $47.50	39 - $48.75	40 - $50.00

Ad No 1—Total words ______ × $1.25 per word = $ ______
All Caps words ______ × .20 per word = $ ______
Bold words ______ × .20 per word = $ ______
Bold Cap words ______ × .40 per word = $ ______
TOTAL COST OF AD No. 1 $ ______

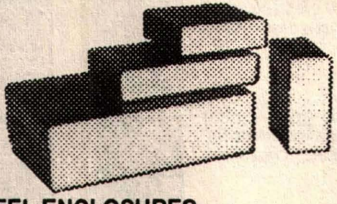
Card # __

Expiration Date __ __ / __ __
Signature ______

Name ______ Phone ______
Address ______ City State Zip ______

BROW MOUNTED BINOCULAR MAGNIFIER

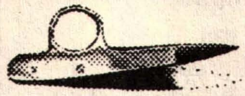
Wear this handy magnifier with its velcro clasp. One size fits all so it's always comfotable. Magnifier assembly tilts up out of the way when not needed. Fixed lens gives 1.8X magnification for most close-up activity. For a closer look a second binocular lens tilts down from inside visor. For turbo pep mode, swivel the loupe in front of the right eye. Combinations are 1.8X, 2.3X, 3.7X and 4.8X. (MP242) **$23.95 each**



STEEL ENCLOSURES

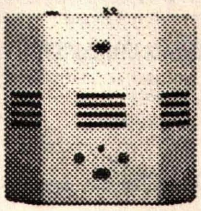
Features include ventilation holes, self-adhesive rubber feet. Front and rear panels are 0.05" aluminum alodine painted white. Top and bottom covers are 0.04" phosphated steel painted black.

CG3119A (2.5" x 6" x 7")	**$14.00**
CG3119B (2.5" x 12" x 7")	**17.00**
CG3119F (2.5" x 17" x 11")	**21.00**
CG3119G (3.5" x 8" x 7")	**15.00**
CG3119K (3.5" x 17" x 11")	**26.00**
CG3114P (5.2" x 17" x 11")	**33.00**
CG3119K (3.5" x 17" x 11")	**26.00**
CG3114P (5.2" x 17" x 11")	**33.00**



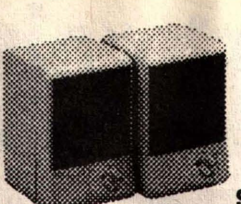
SNIP²

This was designed to be a thread nipper, but in reality it is a spring-loaded stainless steel cutalottastuff tool. The handy eyering allows you to dangle it from your pinky between ops on repetitive work. (SC123) **$8.85 each**



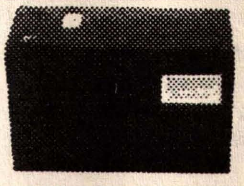
ULTRASONIC LIGHT SWITCH

Replace your light switch with this motion detector. Turns lights on when you enter a room and turns them off when you leave. Has sensitivity and delay adjustments. Specs and instructions included. (95U002) **$9.95 each**



AMPLIFIED SPEAKER PAIR

These units have excellent audio for their small size (approx. 3" x 3" x 5") and are loud enough, too. A 3.5mm stereo plug brings the audio in, and each speaker has its own volume control. They run on 6VDC (four "C" batteries) or an external 6VDC wall transformer. (94V007) **$9.95/pair**



SEALED LEAD-ACID BATTERIES

Five different new, rechargeable units operate in any position. Charge at 10% of AH capacity for 14 hours, less if partially discharged. (Limit charge voltage to 14.5V for 12V units, 7.25V for 6V units.) Sizes given are approximate.

- 12V, 4AH, 2.75" x 4.25" x 3.5". (95E003) **$6.95 eacj**
- 6V, 10AH, 1/875" x 3.75" 5.875". (95E004) **$7.95 each**
- 6V, 6.5AH, 1.875" x 3.75" x 5.875". (95E005) **$4.95 each**
- 6V, 3AH, 1.875" x 2.375" x 5.25". (95E006) **$2.95 each**

SHRINK TUBING ASSORTMENT

Stock up on a good supply of four-foot lengths of popular sizes ranging from 0.125" to 1.5" in various colors. Compare at $70.00. (92Z042) **Twenty 4' Pieces for $8.95**

USED TUBES **$1.00 each**

Your choice. Pulls, test OK.

12AX4	12BE6	13FD7	17DQ6
12AX7	12DQ6	13FG7	50L6
12BA6	12SA7	17AX4	117Z6
12BY7	12L6	17AY3	5814

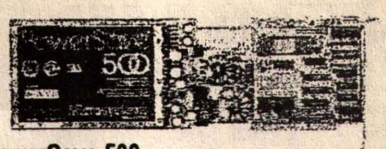
Prices good through 5/31/95.

RESISTOR RIOT

1/8, 1/4, 1/2 Watt, power, precision, fixed, adjustable, etc. Thousands of pieces. (92P023) **5 Lbs. for $4.95**

100° LOW NOISE AMPLIFIER

For TVRO applications. 3.8-4.2 GHz input, 950-1450 mHz outout. Amplica P\N MTI-AG1021. (95G002) **$9.95 each**

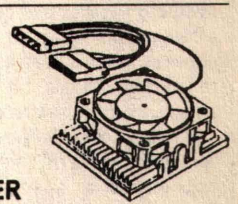


PowerSave 500 UNINTERRUPTIBLE POWER SUPPLY

We have just received a quantity of these internally mounted battery backup units for PC's and PC clones. They use one full-size slot in your PC and monitor the power supply for hickups or outages. When the power goes out:

- 0-2 seconds: PowerSave provides system power to "ride through" short power interruptions without any effect on the user.
- 2-20 seconds: PowerSave initiates a complete system data backup to the hard drive, and returns to user when AC returns.
- 20+ seconds. PowerSave completes system backup and shuts PC off after completion. Application is restored whenever PC power is restored. Application restoration may be automatic or manual, returning you to exactly where you were just befor power loss.

Cool unit! (95C004) **$49.95 each**



'486 CPU COOLER

Fan and heatsink with a state-of-the-art peltier junction attached to keep your '486 CPU ice cold. (95C007) **$44.95 each**

3.5" HIGH DENSITY DISKETTES

Box of ten brand new diskettes. (95C009) **$5.95/box**

3.5" DISK STORAGE FILE WITH LOCK

Holds 48 disks. Perfect Micro P/N PM-48L. **(95C008) $4.95 each**

AT MFM HARD/FLOPPY CONTROLLER

2 Hard drives, 2 floppies, 3:1 interleave. (92C071) **$24.95 each**

DENTAL DRILL MOTOR CONTROLLER

Features reversible DC outputs in two speed ranges (8V and 12V DC), sonalert, switches, power supply and other goodies inside. (94M010) **$14.95 each**

VISA, MC, Amex cards accepted.
Minimum order $15.00.
California residents add sales tax.
Shipping additional on all orders.

ALLTRONICS

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9600 Baud - N-8-1

030595

CIRCLE 215 ON FREE INFORMATION CARD

Since 1956

CAIG
LABORATORIES, INC.

Electronic Chemicals

for Manufacturing, Maintenance & Service

The Next Generation Contact Cleaners, Conditioners and Preservatives

Even the finest equipment cannot guarantee noise-free operation. One "dirty" connection anywhere in the signal path can cause unwanted noise, distortion and signal loss. Considering the hundreds (if not thousands) of connections in electronic equipment today, it is only a matter of time before they begin to fail.

***ProGold** and **DeoxIT** increase the performance and reliability of electrical components and equipment. They provide long-lasting protection, reducing the expense of repeated cleaning with expensive ozone-depleting solvents. As a general rule, use **ProGold** for best performance and protection on plated surfaces and **DeoxIT** as a general purpose treatment.*

ProGold™ Conditioner & Preservative

ProGold outperforms all other contact cleaners, enhancers and lubricants. Due to its unique properties, not only does it deoxidize and clean surface contamination, but it penetrates plated surfaces and molecularly bonds to the base metals. This increases conductivity and contact surface area and reduces arcing, RFI, wear and abrasion - the major cause of intermittent signals, distortion and signal loss. ***ProGold** is the only product that conditions & protects plated surfaces and their base metals.*

Environmentally-Safe!

Environmentally-Safe!

Environmentally-Safe!

DeoxIT™ & PreservIT™

Deoxidizes, Seals & Protects Electrical Connections

DeoxIT is a fast-acting, deoxidizing solution that cleans, preserves, lubricates & improves conductivity on all metal surfaces. Use as a general treatment for connectors, contacts & other metal surfaces.

PreservIT seals, lubricates and preserves metal surfaces for protection from oxidation and contamination. For use on clean/new surfaces or those pre-cleaned with ***DeoxIT***.

Both have excellent migration properties that coat the surfaces and protect them from future oxidation & contamination. These formulas contain improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing & RFI inhibitors and provide extended temperature range.

Environmentally-Safe!

Environmentally-Safe!

Environmentally-Safe!

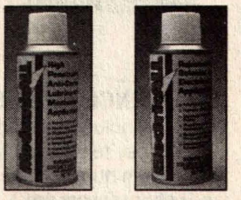
OpticALL™ StaticALL™

OpticALL cleans, polishes and eliminates static electricity on optical viewing surfaces. OpticALL is also recommended as a general purpose antistatic cleaner on plastic, glass and metal surfaces. **StaticALL** neutralizes static build-up caused by friction & low humidity conditions. Use on carpets, floors, clothing & other static generating surfaces.

DustALL™ FreezALL™

DustALL quickly & safely removes dust, lint & particles from sensitive electronic equipment, computers, lab equip., optical grade surfaces & other mechanisms & equipment. **FreezALL** quickly and safely cools circuits to -54°C. Locates intermittent components due to heat failure and hairline cracks on PCBs.

MechanicALL™



High Penetrating Anti-Corrosive Anti-Tarnishing Cleaner & Lubricant. Lubricates & Protects, Displaces Moisture, Stops Squeaks, Migrates & Coats Entire Surface.

ElectricALL™

Rejuvenating Solution For All Electrical Applications. Cleans, Preserves, Improves & Protects Connections, Removes Corrosion & Oxidation, Reduces Wear, Abrasion, Arcing & RFI.

CaiKleen™ 41

Approved Freon TF replacement. Cleaning solvent for equipment and parts. Harmless to metal and most plastics & elastomeric parts. No residue, non-flammable, HCFC blend.

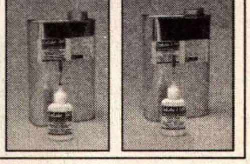
CaiKleen™ TRP

For degreasing, cleaning & defluxing equipment and parts. Removes oil, grease, dirt and contaminants including rosin flux from PCBs, components and metal parts. Biodegradable.

CaiKleen™ IPA

Ultra-pure isopropyl alcohol. Cleaning & degreasing solvent for removal of oil, grease & dirt from instruments, equipment & parts. Use on tape heads, discs, guides, switches, connectors, relays, and other parts for general cleaning.

CaiLube™ 360



Finest quality cutting and lubricating oil for use on various materials; cast-iron, stainless, titanium, gold, platinum, non-ferrous metals, synthetics, etc..

CaiLube™ X-10S Instrument Oil

Contains silicone. Finest quality instrument oil for use on rubber, plastics and metals. Non-gumming, rust inhibiting, long lasting lubrication.

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. . . and many more!

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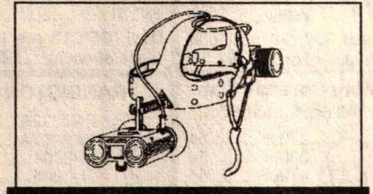
CIRCLE 294 ON FREE INFORMATION CARD

**THE TOTAL COST FOR SHIPPING MOST MIXED ORDERS FROM THIS ADVERTISMENT BY FEDERAL EXPRESS IS $15 - $25
ALL PRICES ARE IN US DOLLARS.**



HEAD MOUNTED IR BINOCULARS

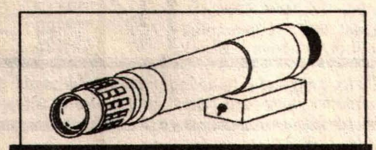
These lightweight USSR made binoculars will produce good vision with 1/4 moonlight illumination, but can also be IR assisted at lower light levels: Work well with our $11 IR filter. Powered by 4 AAA batteries (6V), 1 X magnification, angle of vision 28 deg., focuses from 2' to infinity.

$380

VISIBLE LASER DIODE KIT

Just the basics: A 5mW / 670nM visible laser diode plus a collimating lens, plus an APC driver kit UNBELIEVABLE PRICE:

$26

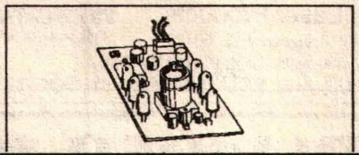


INTENSIFIED NIGHT VIEWER KIT

See in the dark! Make your own night scope that will produce good vision in sub-starlight illumination! We supply a three stage fibre optically coupled image intensifier tube, EHT power supply kit, and sufficient plastics to make a monocular scope. The three tubes are supplied already wired and bonded together.

**$200 for the 25mm version
$280 for the 40mm version**

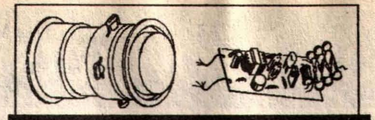
We can also supply the lens (100mm f2: **$50**) and the eyepiece (**$12**) which would be everything that is necessary to make an incredible viewer!



CCD CAMERA

Monochrome CCD Camera which is totally assembled on a small PCB and includes an Auto Iris lens. 9-12V DC operation. It can work with illumination of as little as 0.1Lux, and is IR responsive: Can be used in total darkness with Infra Red illumination. A suitable illuminator is our HIGH POWER LED IR ILLUMINATOR kit. Overall dimensions of camera are 24 X 46 X 70mm and it weighs less than 40 grams! Can be connected to any standard monitor or the video input on a Video cassette recorder: EIA (US - NTSC) compatible.

$145



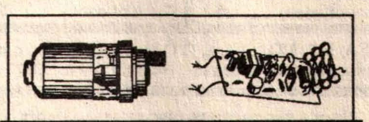
FIBRE OPTIC TUBES

These US made tubes are "pulls" from equipment, in excellent condition. Have 25 / 40 mm diameter, fibre - optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60 mm long, the 40mm tube has an overall diameter of 80mm and is 92mm long. The gain of these is such that they would produce a good image in approximately 1/2 moon illumination, when used with suitable "fast" lens, but they can also be IR assisted to see in total darkness. Our **$11** IR filter is suitable for use with these tubes. Suitable for low light video preamplifiers, wild life observation, etc. Each of the tubes is supplied with an 9V - EHT power supply kit. REDUCED PRICES:

$75 .....For the 25mm intensifier tube and supply kit.

$110 .....For the 40mm intensifier tube and supply kit.

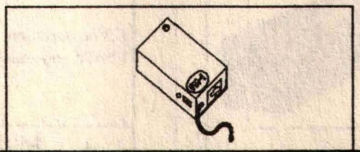
We also have a good supply of the same tubes that may have a blemish which is not in the central viewing area!: Satisfaction guaranteed! !!ON SPECIAL!! $40 .....For a blemished 25 or 40mm (Specify preference) image intensifier tube and supply kit. Matching good quality eyepiece lens only, ***$6 Extra! That's almost a complete night viewer kit for $46.***



IR TUBE AND SUPPLY

A tube and supply combination that can be used as the basis of making a very sensitive IR responsive viewer. The tube employed is probably the most sensitive IR responsive tube we ever supplied, and the EHT supply kit enables the tube to be operated from a small 9V battery. Basic instructions provided.

$80



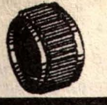
MINIATURE FM TRANSMITTER

Not a kit, but a very small ready made self contained FM transmitter enclosed in a small black metal case. It is powered by a single small 1.5V silver oxide battery, and has an inbuilt electret microphone. SPECIFICATIONS: Tuning range: 88 - 108MHz, Antenna: Wire antenna - attached, Microphone: Electret condenser, Battery: One1.5V silver oxide LR44 / G13, Battery life: 60 hours, Weight: 15g, Dimensions: 1.3" X 0.9" X 0.4".

$25

SECOND GENERATION TUBES

WE SHOULD HAVE A REGULAR SUPPLY OF SOME NEW USSR MADE 18mm 2'ND. GEN. FIBRE OPTICALLY COUPLED IMAGE INTENSIFIER TUBES @ APPROX. **$500.**



INFRA RED FILTER

Very high quality IR filter and a RUBBER lens cover that would fit over most torches including MAGLITE's, and convert them to a good source of IR. Suitable for use with passive and active viewers.

$11

For the filter and the rubber lens cover.

GLASS PRISMS

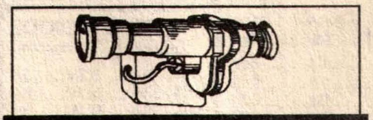
Precision 90 deg. glass prisms with a mirrored backing. We have a limited quantity of these prisms

$10

For the smaller prism: Approximately 18 X 18 X 24 X 64mm.

$20

For the larger prism: Approximately 18 X 18 X 24 X 127mm.



PASSIVE NIGHT VIEWER KIT

See Electronics Now Oct. 94. This kit is based on a BRAND NEW passive night vision scope, which is completely assembled and has an EHT coaxial cable connected. This assembly employs a high gain passive tube which is made in Russia. It has a very high luminous gain, and the resultant viewer will produce useful pictures with starlight illumination. It needs an EHT power supply to make it functional, and we supply a suitable supply and it's casing in kit form.

$220

MISCELLANEOUS ITEMS COMPONENTS AND KITS

FM TRANSMITTER KIT - MKII: $8
SINGLE CHANNEL UHF REMOTE CONTROL KIT: One transmitter and one receiver: $32 additional transmitter $11
4 CHANNEL UHF REMOTE CONTROL KIT: Two transmitters and one receiver: $68
ELECTRIC FENCE KIT: PCB and components $28
GARAGE - DOOR - GATE REMOTE CONTROL KIT: ..Tx $13 ..Rx $56
LASER BEAM COMMUNICATOR KIT: Tx, Rx, plus IR Laser $39
PLASMA BALL KIT: PCB and components kit, needs any bulb $18
HIGH POWER IR LED's - 880nM / 30mW / 12deg. @ 100mA .10 for $6

OATLEY ELECTRONICS
5 LANSDOWNE PDE.. OATLEY.
SYDNEY. NSW. AUSTRALIA 2223

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West Coast between 4pM and 11pm
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Fax: (305) 974-6818

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Margate, FL 33093

POPULAR I.C.s

LM324	45¢
LM339	45¢
LM358	45¢
NE555	40¢
NE556	45¢
LM741	45¢

Deal 'U3': 12 pcs total, (2pcs of each)..........$5

RADIAL 'LYTICS'

1uF/50V	5¢
2.2uF/50V	5¢
3.3uF/50V	5¢
4.7uF/50V	5¢
10uF/25V	5¢
22uF/25V	5¢
33uF/25V	6¢
47uF/25V	7¢
100uF/25V	8¢
220uF/25V	9¢
330uF/25V	10¢
470uF/25V	11¢

Deal 'A9': 60 pcs total, (5pcs of each)..........$5

I.C. SOCKETS

	Solder Tail	Machine Wire Wrap
8 pin	4¢	30¢
14 pin	7¢	54¢
16 pin	8¢	62¢
18 pin	9¢	70¢
20 pin	10¢	78¢
24 pin	12¢	94¢
28 pin	14¢	1.10
32 pin	16¢	1.24
40 pin	20¢	1.56

POPULAR CMOS

CD4001B	25¢
CD4011B	25¢
CD4013B	35¢
CD4017B	35¢
CD4028B	35¢
CD4066B	35¢
CD4069B	35¢

Deal 'V2': 14 pcs total, (2pcs of each)..........$4

Voltage Regulators

7805	47¢
7808	47¢
7812	47¢
7815	47¢
7818	47¢
7824	47¢
7905	50¢
7908	50¢
7912	50¢
7915	50¢
LM317T	80¢
78L05	35¢
78L12	35¢

Deal 'J1': 10pcs (5ea of 78L05 & 78L12)....$3.50

1 W ZENER DIODE

1N4728A	3.3V	6¢
1N4733A	5.1V	6¢
1N4739A	9.1V	6¢
1N4742A	12V	6¢
1N4744A	15V	6¢
1N4746A	18V	6¢

Deal 'Z5': 30 pcs total, (5pcs of each)..........$2

1 AMP SCHOTTKY

1N5817	1A/20V	20¢
1N5818	1A/30V	23¢
1N5819	1A/40V	24¢

Deal 'Y4': 9 pcs total, (3pcs of each)..........$2

3 AMP SCHOTTKY

1N5820	3A/20V	32¢
1N5821	3A/30V	36¢
1N5822	3A/40V	40¢

Deal 'Y9': 9 pcs total, (3pcs of each)..........$3

DIODES

1N914A		3¢
1N4148		2¢
1N4001	1A/50V	3¢
1N4004	1A/400V	4¢
1N4007	1A/1kV	5¢

Deal 'P7': 50 pcs total, (10pcs of each)........$2

POWER DIODES

1N5401	3A/100V	7¢
1N5404	3A/400V	8¢
1N5408	3A/1kV	9¢
6A10	6A/100V	20¢
6A100	6A/1kV	30¢

Deal 'H8': 25 pcs total, (5pcs of each)..........$3

5mm (T1 3/4) Diffused LEDs

Red	7¢
Green	8¢
Yellow	9¢

Deal 'L3': 30 pcs total, (10pcs of each)...$2.50

CERAMIC DISC
(All caps rated 50V)

10pF	5¢
22pF	5¢
27pF	5¢
33pF	5¢
47pF	5¢
100pF	5¢
150pF	5¢
220pF	5¢

Deal 'R4': 40 pcs total, (5pcs of each).....$2.50

TANTALUM CAPS

1uF/35V	18¢
2.2uF/35V	20¢
10uF/35V	35¢

Deal 'T6': 15 pcs total, (5pcs of each).....$3.50

Toggle Switches

Miniature size
1/4" Panel hole

on-on	SPDT	60¢
on-on	DPDT	68¢
on-off-on	DPDT	85¢

Deal 'S7': 6 pcs total, (2pcs of each)..........$4

3mm (T1) Diffused LEDs

Red	7¢
Green	8¢
Yellow	9¢

Deal 'L6': 30 pcs total, (10pcs of each)...$2.50

More Ceramic Caps
(All caps rated 50V)

270pF	5¢
330pF	5¢
470pF	5¢
.001uF	5¢
.01uF	5¢
.022uF	5¢
.047uF	6¢
.1uF	6¢

Deal 'R7': 40 pcs total, (5pcs of each).....$2.50

MONO CAPS.....6¢ea

.01uF/50V .047uF/50V
.022uF/50V .1uF/50V

Deal 'B5': 40 pcs total, (10pcs of each)...$2.50

1/4W 5% Resistors

10, 47, 100, 470, 1K, 4.7K
Deal 'W2': 120pcs total, (20 of ea above)...$2.50

10K, 47K, 100K, 470K, 1M
Deal 'W5': 100pcs total, (20 of ea above)...$2.50

Germanium Diodes

1N34A	12¢
1N60	12¢
1N270	18¢

Deal 'G5': 18 pcs total, (6pcs of each).....$2.50

TRANSISTORS

PN2222A	6¢
PN2907A	6¢
2N3904	6¢
2N3906	6¢
2N4401	6¢
2N4403	6¢

Deal 'N8': 60 pcs total, (10pcs of each)...$3.50

More Transistors

2N2222A	30¢
2N4124	8¢
2N4126	8¢
MPSA05	9¢
MPSA13	14¢
MPSA27	14¢
MPSA42	12¢
MPSA56	10¢
MPSA92	10¢
MPSH10	10¢
2N3055	52¢
TIP31C	40¢
TIP32C	40¢
TIP117	50¢
TIP120	50¢
TIP125	50¢

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CIRCLE 296 ON FREE INFORMATION CARD

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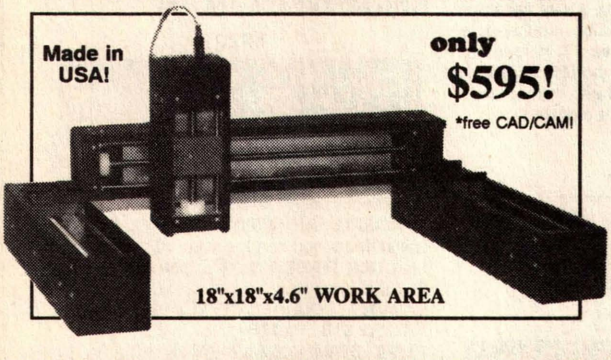

Made in USA!

only $595!
*free CAD/CAM!

18"x18"x4.6" WORK AREA

THIS IS THE MACHINE YOU'VE BEEN WAITING FOR!

Have you ever dreamed of letting your computer prototype PC boards directly from your CAD drawings? If so, the Neuractor CNC-4+ Desktop Manufacturing System may be just the machine you need! This fourth-generation CNC machining center can automatically drill, mill and route printed circuit boards, not to mention three-dimensional products in wood, plastic and light metals DIRECTLY FROM YOUR CAD DRAWINGS! You've seen the rapid-prototyping and "Santa Claus" machines that cost thousands of dollars, but did you know that as an electronic technician you can assemble one yourself from this inexpensive kit? Utilizing patent pending technology the Neuractor CNC-4+ kit provides you with everything you need to machine products in three dimensions with a resolution of .001". All mechanical components are pre-fabricated, pre-machined, plated and painted. Includes four 83 oz/in digital CY-MOTORs, interface card, 5 amp power supply, 10 pitch steel lead screws, 4 proprietary Slide Block actuator mechanisms, 4 aluminum linear actuator channels, polished steel guide-rods, Dremel bracket, hardware, etc. (You provide Dremel MotoTool(tm) or flex-shaft router and work surface.) It's a complete kit! All you do is put it together and calibrate it! IF THAT'S NOT ENOUGH, WE'RE THROWING IN A FREE FULL-FEATURED 3D CAD/CAM SOFTWARE PACKAGE WITH EACH UNIT! Large 18"x18"x4.6" cutter travel directly from CAD-generated or scanned ASCII, DXF & HPGL plot files !. Get started by ordering your own Neuractor CNC-4+ today! ACT NOW! Kit $595 + $24.95 S/H. (For PC board routing the heavy-duty upgrade is suggested, add $149) Allow 4-8 weeks for del. U.S. CYBERLAB, 14786 Slate Gap Rd., West Fork, AR 72774 (501) 839-8293.

Free info! X-Y Power/Rotary Tables and larger CNCs now available!

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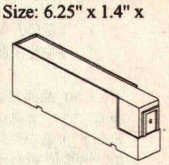
Helium-Neon Laser

Why mess with soldering a kit together and taking a risk of it working when you can have a complete functional laser for less. High brightness red laser visible for up to a mile. Use in many projects such as light shows, holography, and laser eavesdropping. Output: 1.0-1.8mW; Class IIIa. Size: 6.25" x 1.4" x 2.25". One year warranty!



12Vdc operation (Cat. #: HNM2-12)	$49.00
120VAC operation- includes adaptor	$59.00

Quantity discounts available.

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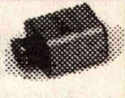
LIVE TV VIDEO



New in 1995! **The MiniLink II 2.4 GHz video system. 5 (five) channels available and audio is included. Each channel is switch selectable right on the unit, no soldering or rewiring, and it is fully assembled No kit to lose parts and not a cheep modified UHF TV tuner.** Transmit live video to any *TV. New advanced technology now allows micro TV transmitter to be carried anywhere. This is a FCC certified system and *NO* license is required. *Lowest cost Highest Quality.*
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INTEL LANDesk Manager 1.02 **$125.00**

This is a central control for managing Networked PC's. Can be upgraded to newest version of 2.0 for a nominal fee, saving 100's of dollars off the 2.0 price.

3-MEG AT Class/386/16-Bit Memory Board **$10.95**

New Everex Model EV159, supports extended & expanded memory LIM 4.0 with documentation & software. Uses 256K RAM. Will populate for $23.40 per meg.

Quarterdeck expanded memory manager **$9.95**
386, Version 6.0

386 DX33 (INTEL) Serial, parallel, floppy & IDE hard drive controller with passive back plane included **$85.00**

FLOPPY DRIVE New, 360K DSDD **$9.95**

XT Motherboard 8 Slots, 8 MHz, ... **$15.95**

XT MOTHERBOARD **$19.95**
10 Mz, includes CPU, BIOS, serial, parallel, game, clock, light pen interface, CGA, Mono, NTS, & floppy controller, 360, 720, 1.2, & 1.44, fits low-profile desktop w/ horizontal slots. FANTASTIC BOARD! Quantity limited

PC MOTHERBOARD BY HYUNDAI **$12.95**
With serial, parallel, floppy controller. Space for 512K memory on board.

MAGNETIC CREDIT CARD READER
By Magtek **$12.95**

MAGNETIC CHECK READER
By Magtek **$14.95**

SOLAR CELLS
By Siemens - .456V, 2.0 AMPS **$4.00**

CASH REGISTER SYSTEM **$149.00**
For IBM Compatible PC's. Complete package includes cash drawer, controller board, and free POS software. Features include - accounts receivable, inventory, sales personnel, accounting, printed reports and POS.

LASERS

Lasers 3-4 Mw HeNe **$22.95**

Lasers 6-7 Mw HeNe **$29.95**

Laser Assembly **$55.00**
★ Model 750F, includes laser, power supply, polygon scanner, mirrors, detectors, & optics, runs on 115 VAC

Visible Laser Diodes (visible red light)
1Mw .... **$8.00** 2Mw **$11.00**

Laser Diode **$15.00**
5mW, by Toshiba, brand new, TOLD9200, without focusing lense

Laser Diode Kit **$49.00**
To power TOLD9200, includes laser diode, board, parts, instructions

Laser Tubes **$29.95**
From SIEMENS, brand new, 5mW HeNe

IC MEMORY CARD **$95.00**
Buffalo RJB-1000, SCRAM card - 1 Meg PC-MCIA 2.0 JEIDA SCRAM Memory Card by Melco Inc. Type 1 card, thinnest to fit type 2 or 3 slots. Will fit device meeting standard: HP95LX, Sharp, NCR, etc. Elsewhere for $150. Our price is ***BELOW WHOLESALE!***

ARCNET CARD By PB-LINK **$19.95**
8-bit, supports 50, 75, & 93 type cable, Packard Bell

ELECTRONIC THERMOMETER **$29.00**
Model 1003, Range -75 to +1999° F, also measures Centigrade, uses NiCr/NiAL sensor (not incl.) by Ricoh

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For Windows. Image creation & image editor. Paint, draw & scanning program, color correction & separation.

RLL CONTROLLER DATA TECH. **$19.95**

Floppy Disk Controller Board **$9.95**
Dual, 360K or 720K switch selectable

SCSI 8-bit CONTROLLER **$35.00**
by FUTURE DOMAIN TMC 830

SCSI Cable (male DB25 to male Centronics 37) **$7.00**

CCD SCANNER BOARD **$24.95**
Uses a 4096-element line imaging chip. Can use for robotics, astronomy, machine vision, high resolution slow scan TV, etc. Supplied with documentation.

STEPPER MOTOR **$17.95**
by Oriental Motor, Model #PH566-A-Q5, 500 steps per rev., 0.72° per step

LCD MODULE 2 line by 16 character **$14.00**

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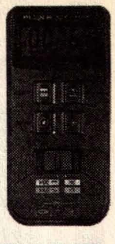
Ultimate 12" AU1290 Dual VC Subwoofer

Just one listen to this 12" dual voice coil subwoofer from Ultimate will leave no doubt that this sub can shake, rattle, and roll! Works extremely well in car audio, home theatre, or satellite/subwoofer systems. Handcrafted in the U.S.A.
◆Power handling: 350 watts RMS/500 watts max ◆Voice coil diameter: 2 inch ASV voice coil ◆Impedance: 6 ohms per coil ◆Frequency response: 18-1,000 Hz ◆Magnet weight: 90 oz. ◆Fs: 21 Hz ◆SPL: 88 dB 1W/1m ◆Vas: 5.9 cu. ft. ◆Qts: .421 ◆Xmax: .41" ◆Net weight: 11 lbs.

#EN-292-710 .... **\$115.50**(1-3) **\$107.80**(4-11) **\$99.90**(12-UP)

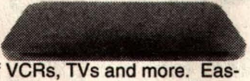
Fluke Model 12 Multimeter



The Model 12 compact digital multimeter combines basic features, high performance, low cost and Fluke reliability. It was designed for first level electrical and electronic troubleshooting. Includes 9V battery, operating manual, and test leads. Two year manufacturer warranty.
Features: ◆Measures AC/DC volts, ◆4000 count digital display, ◆Autoranging, ◆Automatic shut off, ◆Diode and continuity test, ◆1.5% accuracy, ◆V Chek™ overload protection mode, ◆Capacitance check to 999 uF, ◆0.9% accuracy, ◆Min/Max Record with time stamp, ◆Input change alert, ◆Continuity Capture™ (captures and records intermittent opens and shorts), ◆Net weight: 1 lb.

#EN-392-020 .... **\$92.50**

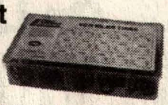
Technicians' Turntable



Turntable to speed repair of VCRs, TVs and more. Easily turn unit for convenient repair. Holds up to 200 lbs. Dimensions: 20" W x 15" D x 1-1/8" H. Black pebbled surface. Includes 4 anti-skid adhesive feet. Net weight: 9 lbs.

#EN-360-427 **\$28.50**(1-3) **\$23.80**(4-UP)

Idler Tire Kit



Have the tire you need in stock when you need it. This comprehensive kit contains 180 of the most commonly used tires in an easy-to-use case and a cross reference for 32 manufacturers crossing to over 600 VCR model numbers. A \$400.00 retail value. Net weight: 1-1/2 lbs.

#EN-400-900 .... **\$39.95**KIT

Leatherman Tool

The Leatherman tool is an extremely versatile and durable compact toolchest you can hold in your hand ... contains 12 useful tools in one! Needlenose pliers, regular pliers, awl, Phillips screwdriver, three slotted screwdrivers, can and bottle opener, wire cutters, file, knife, and 8 inch ruler. Made of only the highest quality 100% stainless steel. Includes sturdy leather sheath. 25 year manufacturer warranty. Net weight: 5 oz.

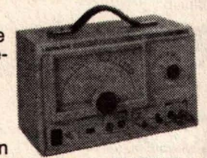
#EN-360-990 .... **\$39.95**(1-3) ..... **\$37.50**(4-UP)

Vifa D25TG-05 1" Poly Dome Tweeter

Excellent performance at a moderate price. This ferro fluid cooled 1" poly dome tweeter features a high loss diaphragm, user replaceable voice coil assembly, and high power handling.
◆Power handling: 100 watts RMS/140 watt max ◆Nominal impedance: 6 ohms ◆DC resistance: 4.6 ohms ◆Frequency range: 3,000-24,000 Hz ◆Magnet weight: 8.5 ozs. ◆Fs: 1500 Hz ◆SPL: 90 dB 1W/1m ◆Net weight: 1-1/4 lbs.

#EN-264-502 .... **\$18.50**(1-3) **\$16.80**(4-11) **\$15.45**(12-UP)

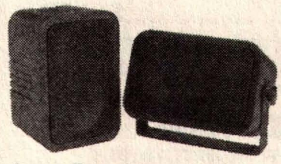
Audio Generator



Square wave and sine wave generator useful for a variety of audio applications. Generates 10 Hz to 1 MHz in 5 ranges. Output voltage: 8V RMS sinewave, 10V p-p squarewave. +/-3% dial accuracy. Output impedance: 600 ohms. Synchronization: +/-3% of oscillation frequency per VRMS. Dimensions: 6"H x 10"W x 5"D. Includes test lead, AC power cord, and manual. One year manufacturer warranty. Net weight: 6 lbs.

#EN-390-620 .... **\$119.00**

Mini Weatherproof Speaker System



These mini weatherproof speaker cabinets are made from high impact polypropylene which is completely weather sealed making these perfect for indoor or outdoor use. These great sounding mini speakers feature a 5" polypropylene cone woofer and a mylar dome tweeter. Ideal for use as extension speakers or for surround sound. Small size blends easily into any decor. Frequency response: 130-20,000 Hz. 8 ohm impedance: 30 watts RMS, 60 watts maximum power handling capability. Mounting brackets included. Dimensions: 8" (H) x 5-1/2" (W) x 4-1/2" (D). Net weight: 10 lbs.

#EN-310-020 (Black)
#EN-310-025 (White) .... **\$79.95**(1-3 PRS) ... **\$74.80**(4 PRS-UP)

Professional Strobe Light

No top notch lighting display is complete without a powerful, high speed strobe light. This professional unit features an ultra bright xenon flash tube, reflective bowl, variable speed control, and on/off toggle switch. A 1/16" clear plexiglass cover is mounted on brass stand-offs to protect the flash tube assembly. Includes adjustable mounting bracket. Dimensions: 9-1/2" (W) x 8-5/8" (H) x 6-7/8" (D). Net weight: 7 lbs.

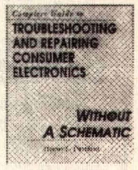
#EN-243-072 .... **\$92.80**

6-1/2" Two Way In-Wall System

This is our most popular in-wall. You won't believe how good these really sound. Big enough to produce great home theater sound and still fit everyone's budget. Put a pair in every room of your house. Great for front or rear speakers in your surround system. The 6-1/2" polypropylene woofer and 1" textile dome tweeter were specially designed with home theater in mind. The crossover network utilizes a mylar capacitor for crisp clean highs. 3 piece design make installation in new or existing walls a snap. Textured ABS frame and steel mesh grill are spray paintable to match (or blend into) any decor. Speaker front plate is "blacked out" for cleaner "through grill" appearance. System comes with speaker assembly, removable metal grill, heavy steel backer plates, screws and hardware, hole cut-out template, paint mask, and detailed installation instructions.
Specifications: ◆6-1/2" polypropylene cone woofer with poly foam surround. ◆1" textile dome tweeter/midrange. ◆8 ohm impedance. ◆3 component L/C crossover network. ◆Frequency response: 50-20,000 Hz. ◆Power handling capability: 60 watts RMS/100 watts max. ◆Sensitivity: 89 dB 1W/1M. ◆Overall dimensions: 8-1/2" W x 12" L x 3-1/2" D. ◆Hole size: 7-1/4" x 10-3/4". ◆Fits into standard 2" x 4" wall. ◆Net weight: 12 lbs. per pair.

#EN-300-036 .... **\$104.95**(1-3 PRS) **\$96.50**(4-11 PRS) **\$85.50**(12 PRS-UP)

Troubleshooting And Repairing Consumer Electronics Without A Schematic



A common problem faced by repair technicians is having to troubleshoot electronic equipment without a schematic. With hundreds of illustrations, this indispensable guide demonstrates how to locate, test, and repair amplifiers, TVs, CD players, radios, power supplies, and more. Written by Homer L. Davidson. 320 pages. Copyright: 1994. Net weight: 1-1/4 lbs.

#EN-500-305 .... **\$22.95**EACH

Isotip Butane Soldering Iron

The ideal soldering iron for field repairs where no AC power is present. Operates for up to 100 minutes of continuous soldering per refill. Uses standard butane (not included) available at most stores. Tip temperature is adjustable up to 1067° F. Iron also comes with a torch attachment which easily screws on in place of the soldering tip. As a torch, one refill will provide up to 1 hour of continuous flame. Temperature is adjustable up to 2372° F. A protective cap with a built-in striker and 2.4mm tip are included. Limited one year warranty.

ISOTIP
cordless soldering iron

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Parts Express™

3-In-1 Universal Remote

This remote will operate any remote controlled cable box, TV or VCR at just a fraction of the cost of a factory replacement! This unit is already preprogrammed to include the most common codes. It is attractively styled, durable, and easy to set up and operate. The manufacturer even offers a toll free consumer help line to answer questions and provide customer assistance. Requires 2 AAA batteries (not included).

#EN-180-565 .... **$\$11.95_{(1-9)}$ $\$9.95_{(10-UP)}$**

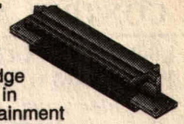
The Wet Look™

The Wet Look™ is a new generation of high gloss polymers formulated especially for the speaker industry. This superior coating provides a protective "coat of armor" for your paper cone speakers. A special U/V inhibitor has been added to reduce the decaying effects of the sun's ultraviolet rays. The Wet Look™ makes paper cones resistant to water, humidity, sun, and salt. Best of all, it's easy to apply and cleans up with soap and water. 1 pint can.

The Wet Look

#EN-340-510 (Clear) .... **$\$8.95_{EACH}$**
#EN-340-512 (Black) .... **$\$8.95_{EACH}$**

72 Pin Game Cartridge Connector

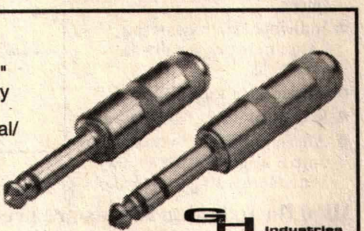


Quality replacement for the game cartridge connector used in Nintendo Entertainment Systems (NES). Repeated loading and removal of game cartridges damages the connector contacts and produces symptoms such as a flashing blank screen or distorted picture. Revitalize your unit by replacing the game connector. It's simple; there is no soldering required and only a phillips head screwdriver is needed to complete installation in minutes! Our replacement connector has gold plated game contacts for long life, superior conductivity, and resistance to oxidation. One year warranty.

#EN-091-900 **$\$8.95_{(1-9)}$ $\$7.95_{(10-UP)}$**

BigFoot™

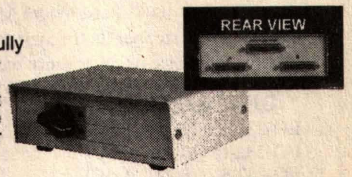
"Copper tip" design standard 1/4" phone plug. Unsurpassed quality ensures low noise and high conductivity connection. All metal/nylon construction with external solder connections. Insulator sleeve included. 5/16" ID barrel. Made in the U.S.A.



GH Industries

#EN-092-200 (Mono) .... **$\$2.25_{(1-9)}$ $\$1.95_{(10-49)}$ $\$1.75_{(50-UP)}$**
#EN-092-206 (Stereo) .... **$\$3.25_{(1-6)}$ $\$2.90_{(10-49)}$ $\$2.65_{(50-UP)}$**

RS-232 A-B Switch

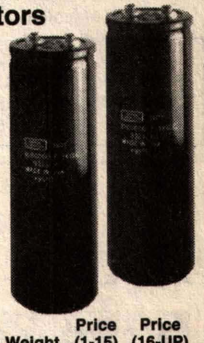


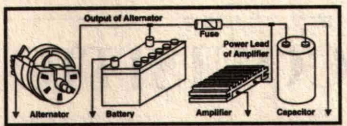
High reliability rotary type switch. Fully shielded, heavy gauge steel construction with gold plated connectors. All pins switched through (except ground). Used to switch multiple printers or computers. Full one year warranty. Net weight: 1-3/4 lbs.

#EN-130-010 .... **$\$9.95_{(1-2)}$ $\$8.95_{(3-9)}$ $\$7.95_{(10-UP)}$**

Car Stereo Power Supply Capacitors

Most car amplifiers' power supplies simply lack the capability to produce large amounts of instantaneous power. These computer grade, car stereo capacitors work by storing energy and supplying, on demand, a quick burst of energy to the power amplifier. The result is tremendous bass punch and dramatically improved transient response. Feature gold plated terminals.

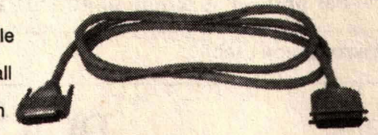




Part #	Value	Voltage	Dimensions	Weight	Price (1-15)	Price (16-UP)
EN-029-1000	1,000,000 uf	16 VDC	3"(dia.) x 8-1/2"	3 lbs.	$59.80	$52.80
EN-029-1005	1,000,000 uf	20 VDC	3"(dia.) x 8-1/2"	3 lbs.	79.80	73.50

Printer Cables

25 pin male RS-232 to 36 pin male Centronics connector. Fully shielded and molded cable with all 25 conductors connected. Convenient thumbscrew hardware on the RS-232 connector.

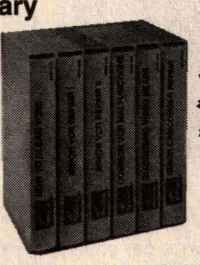


Part #	Length	Price (1-9)	Price (10-49)	Price (50-UP)
EN-130-220	6 ft.	$4.50	$3.90	$2.90
EN-130-225	10 ft.	5.50	4.95	3.75
EN-130-227	15 ft.	8.50	7.90	5.90
EN-130-228	25 ft.	10.90	9.50	7.90
EN-130-229	50 ft.	19.80	17.50	14.90

Video School videos make it easy for anyone to comprehend the complex operations of VCRs, camcorders, and more. From How to Clean VCRs for the video rental store, to Minor Camcorder Repair for the advanced service shop. There is something for everyone! These tapes also make great new employee orientation videos.

Electronic Video Library

Save over $25.00 by purchasing this complete library of six Video School instructional videos. You'll receive VCR 1-How To Clean VCRs, VCR 2-Minor VCR Repair I, VCR 3-Minor VCR Repair II, VCR 4-Common VCR Malfunctions, VCR 5-Diagnosing Video Heads, and Cam 1-Minor Camcorder Repair. Net weight: 5 lbs.



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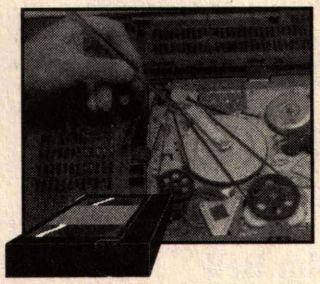
#EN-505-550 .... **$\$195.00_{EACH}$**

Part #	Description	Price
EN-505-010	VCR 1, How To Clean VCRs	$28.95
EN-505-020	VCR 2, Minor VCR Repair I	38.95
EN-505-025	VCR 3, Minor VCR Repair II	38.95
EN-505-050	VCR 4, Common VCR Malfunctions	38.95
EN-505-035	VCR 5, Diagnosing Video Heads	38.95
EN-505-030	VCR Test Patterns Alignment Tape	23.95
EN-505-040	Cam 1, Minor Camcorder Repair	38.95
EN-505-085	Microwave Oven Repair	39.95
EN-505-080	Nintendo Repair and Maintenance	33.95
EN-505-090	IBM Compatible Computer Assembly	28.95
EN-505-095	Hi-Fi Alignment Test Tape	29.95



Skew Driver Pro

This unique tool features a gear driven offset bit driver to be used in tight spots or where conventional screwdrivers just won't fit. Includes 1/4" and 3/16" slotted bits, T15 Torx® bit, and 2 phillips bits that are contained in the handle compartment. Can also be used with a 1/4" electric drill. Made in the U.S.A. Net weight: 1/2 lb.

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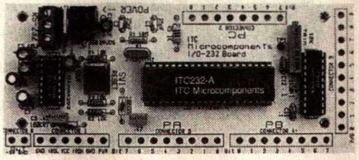
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- 10-10,000 Hz, 0-100% Pulse Width Modulation output.
- 3 EASY to use stepper motor logic interfaces (Muxable to more).
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DESCRIPTION	**KIT**	**ASSEMBLED**
I/O-232-12 (12 bit ADC)	$ 109	$ 119
I/O-232-10 (10 bit ADC)	$ 99	$ 109
I/O-232-8 (8 bit ADC)	$ 79	$ 89

Enclosure: $14, Serial cable: $9 (specify connector), Power Supply: $11 Add $10 for manuals, diskette containing program examples and Shipping & Handling. Pay by cheque, M. Order, VISA or Master Card.

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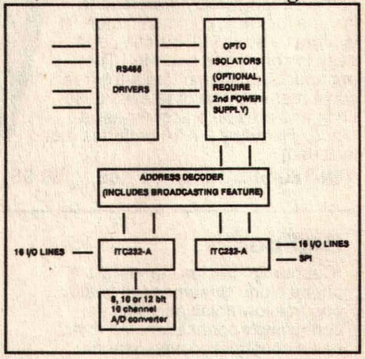
I/O-485 boards block diagram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ITC232-A
ITC232-A
16 I/O LINES
SPI
8, 10 or 12 bit 10 channel A/D converter

- 32 I/O lines configurable individually as Inputs or latched Outputs organized in 4 x 8 bit ports.
- 10 analog inputs, 8, 10 or 12 bits resolution.
- 32 different addresses plus broadcasting which allows commanding all the boards at once.
- Individual stations or the entire network is software resetable
- Direct or optoisolated link
- Speeds of up to 115200 Bauds.
- All the stations can be hooked onto a single 4 wire cable up to 1 mile long using standard phone jacks.

All of the following boards are pre-assembled and tested.

I/O-485-8 (8 Bit ADC)	**$ 139**
I/O-485-10 (10 Bit ADC)	**$ 159**
I/O-485-12 (12 Bit ADC)	**$ 179**
432/485 Converter	**$ 49**

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For optoisolated option: Add $19 to each item.

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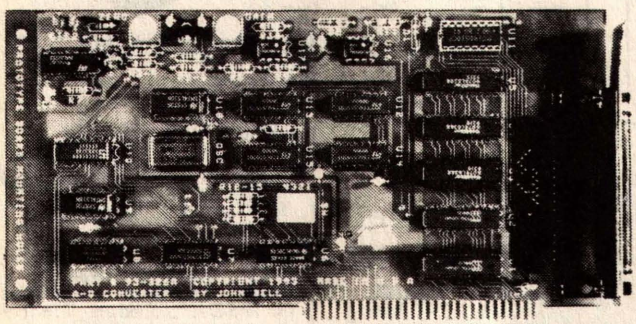
DATA ACQUISITION


PART # 93-326A COPYRIGHT 1993 MADE IN U.S.A.
A-D CONVERTER BY JOHN BELL

12 Bit 8 Channel A-D Converter

IBM Compatible - Input voltage 0 to 2 volts (0.00048 volts per count). Conversion time <1ms. Accuracy is better than +/- 2 counts. Linearity is better than +/- 1%. Part #93-326A $149.95. Also a 50 KHz sample rate with 8 bit conversion. $179.95 This board has one 8 bit TTL input port and one 8 bit TTL output port and comes with a diskette with BASIC programs for Data logging, Low Frequency Oscilloscope, Temperature measurement using a Radio Shack Thermistor, and Voltage measurement.

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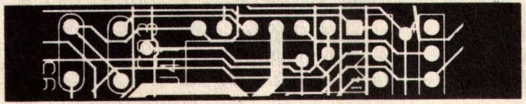

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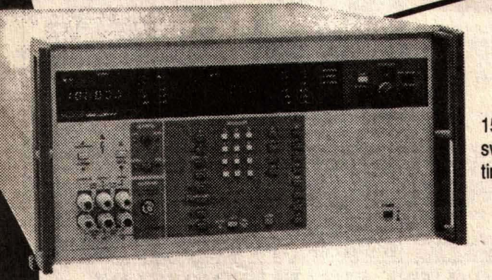

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Fluke 6071A Synthesized RF Signal Generator

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General Radio 1419A Decade Capacitor

0 to 1.11 µF, .001µF per step, 3 decades ±1%.

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General Radio 1423A Precision Decade Capacitor

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Hughes 45714H-1000 Frequency Meter

Direct reading frequency meter, V band 50 to 75 GHz, round flange type.

$795.00

Hughes 45712H-1000 Frequency Meter

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Tektronix 475A Oscilloscope

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Tektronix 2445A Oscilloscope

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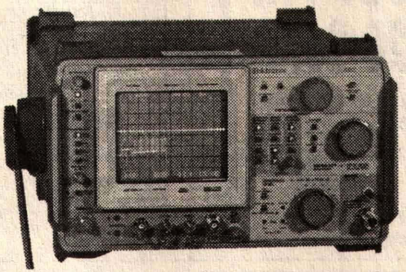
Tektronix 492 Spectrum Analyzer

50 kHz to 21 GHz, 80 dB dynamic range, amplitude comparison in 0.25 dB steps.

$7500.00



Tektronix 496P Programmable Spectrum Analyzer

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Tektronix P6022 Current Probe with Termination

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Wavetek 7580.1 Step Attenuator

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Wavetek SAM 1-450 Signal Level Meter

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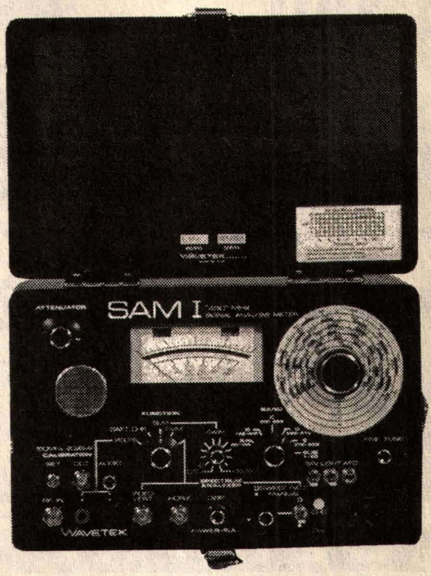

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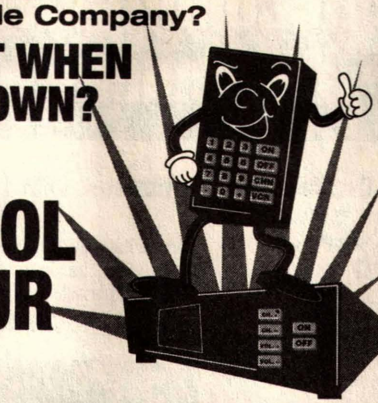

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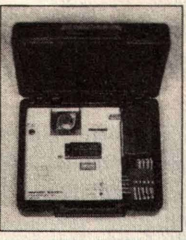

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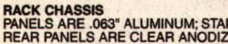

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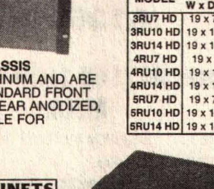

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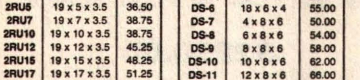

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1RU17	19 x 17 x 1.75	48.75
2RU5	19 x 5 x 3.5	36.50
2RU7	19 x 7 x 3.5	38.75
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2RU17	19 x 17 x 3.5	51.25
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3RU17	19 x 17 x 5.25	60.00

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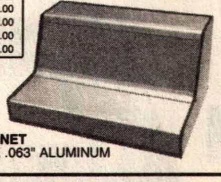
MODEL	SIZE W x D x H (in)	PRICE $
DS-1	4x 6 x 4	40.00
DS-2	6 x 6 x 4	43.00
DS-3	8 x 6 x 4	46.00
DS-4	10 x 6 x 4	49.00
DS-5	12 x 6 x 4	52.00
DS-6	18 x 6 x 4	55.00
DS-7	4 x 8 x 6	50.00
DS-8	6 x 8 x 6	54.00
DS-9	8 x 8 x 6	58.00
DS-10	10 x 8 x 6	62.00
DS-11	12 x 8 x 6	66.00
DS-12	18 x 8 x 6	70.00



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SB-1	2.1 x 1.9 x 1.0	4.50
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SB-3	4.2 x 1.9 x 1.0	9.00
SB-4	6.3 x 1.9 x 1.0	10.50
SB-5	3.3 x 2.7 x 1.1	9.50
SB-6	4.8 x 2.7 x 1.1	11.50
SB-7	6.4 x 2.7 x 1.1	13.20
SB-8	2.6 x 2.7 x .63	7.00
SB-9	3.2 x 2.7 x .63	8.25
SB-10	4.8 x 2.7 x .63	9.00
SB-11	6.3 x 2.7 x .63	10.75
FTS-1	1000pF/50VDC SOLDER TYPE	.85
FTSI-1	1000pF/50VDC SCREW-IN TYPE	3.50

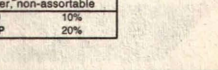
HEAVY DUTY RACK CHASSIS
PANELS ARE .080" ALUMINUM AND ARE FIELD REMOVABLE; STANDARD FRONT & REAR PANELS ARE CLEAR ANODIZED, BLACK PANELS AVAILABLE FOR ADDITIONAL $15.00

HEAVY DUTY RACK CHASSIS

MODEL	SIZE W x D x H (in)	PRICE $
3RU7 HD	19 x 7 x 5.25	120.75
3RU10 HD	19 x 10 x 5.25	127.00
3RU14 HD	19 x 14 x 5.25	140.75
4RU7 HD	19 x 7 x 7.0	127.00
4RU10 HD	19 x 10 x 7.0	135.50
4RU14 HD	19 x 14 x 7.0	140.75
5RU7 HD	19 x 7 x 8.75	132.25
5RU10 HD	19 x 10 x 8.75	139.75
5RU14 HD	19 x 14 x 8.75	150.25

METAL CABINETS

MODEL	SIZE W x D x H (in)	PRICE $
MC-1A	4 x 3 x 2	12.00
MC-2A	6 x 3 x 2	14.00
MC-3A	8 x 3 x 2	16.00
MC-4A	4 x 5 x 3	14.00
MC-5A	6 x 5 x 3	16.00
MC-6A	8 x 5 x 3	18.00
MC-7A	4 x 7 x 4	16.00
MC-8A	6 x 7 x 4	18.00
MC-9A	8 x 7 x 4	20.00



METAL CABINET
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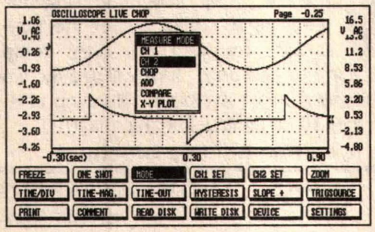
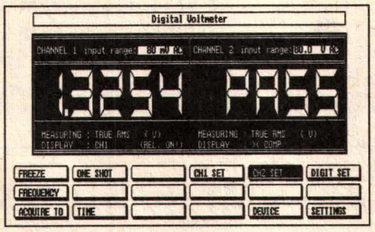
* oscilloscope



OSCILLOSCOPE LIVE CHOP
Page -0.25
1.06
V AC
-0.26
-0.93
-1.60
-2.26
-2.93
-3.60
-4.26
16.5
V AC
11.2
8.53
5.86
3.20
0.53
-2.13
-4.80
-0.30(sec)
0.30
0.90
MEASURE MODE
CH 1
CH 2
CHOP
ADD
COMPARE
X-Y PLOT
FREEZE
ONE SHOT
MODE
CH1 SET
CH2 SET
ZOOM
TIME/DIV
TIME-MAG.
TIME-OUT
HYSTERESIS
SLOPE +
TRIGSOURCE
PRINT
COMMENT
READ DISK
WRITE DISK
DEVICE
SETTINGS

* voltmeter


Digital Voltmeter

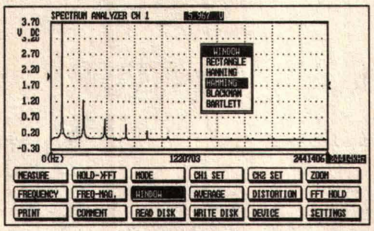
CHANNEL 1 input range: 80 mV AC CHANNEL 2 input range: 80.0 V AC

1.3254 PASS

MEASURING : TRUE RMS (V) MEASURING : TRUE RMS (V)
DISPLAY : CH1 (REL. ON!) DISPLAY : >< COMP

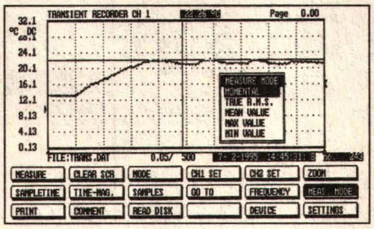
FREEZE
ONE SHOT
CH1 SET
CH2 SET
DIGIT SET
FREQUENCY
ACQUIRE TO
TIME
DEVICE
SETTINGS

* spectrum analyzer



SPECTRUM ANALYZER CH 1
3.70
V DC
2.70
2.20
1.70
1.20
0.70
0.20
-0.30
0(Hz)
1220703
2441406
WINDOW
RECTANGLE
HANNING
HAMMING
BLACKMAN
BARTLETT
MEASURE
HOLD->FFT
MODE
CH1 SET
CH2 SET
ZOOM
FREQUENCY
FREQ-MAG.
WINDOW
AVERAGE
DISTORTION
FFT HOLD
PRINT
COMMENT
READ DISK
WRITE DISK
DEVICE
SETTINGS

* transient recorder



TRANSIENT RECORDER CH 1
Page 0.00
32.1
°C DC
24.1
20.1
16.1
12.1
8.13
4.13
0.13
FILE:TRANS.DAT
0.05/ 500
7- 2-1995 14:45:31
MEASURE MODE
MOMENTAL
TRUE R.M.S.
MEAN VALUE
MAX VALUE
MIN VALUE
MEASURE
CLEAR SCR
MODE
CH1 SET
CH2 SET
ZOOM
SAMPLETIME
TIME-MAG.
SAMPLES
GO TO
FREQUENCY
MEAS. MODE
PRINT
COMMENT
READ DISK
DEVICE
SETTINGS

Normally, you have to use more than one instrument to take your measurement. Together with the TiePie instruments a complete software package is delivered, in order to realize all four measuring-instruments. Your advantage is that you only need ONE measuring instrument! Moreover, you will be able to control all instruments in the same way.

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➡ **TP5008**
8 bits; 2 channels; 200 kHz; interface card US $307

➡ **TP208**
8 bits; 2 channels; 20 MHz; interface card US $998

➡ **AD128**
12 bits; 8 channels; 100 kHz; interface card US $279

➡ **TP112**
12 bits; 2 channels; 1 MHz; interface card US $1170

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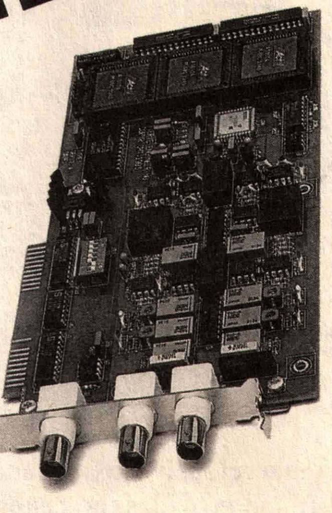

The TP508 is a new interface card with a measuring frequency of 50 MHz!! The resolution of this card is 8 bits.

Phenomena shorter than 1 millionth of a second can still be measured well. The completely digitized triggering ensures very stable triggering with many trigger possibilities. The TP508 has an input range of 5 mvolt/div...20 volt/div (12 steps) and an auto calibration function. Since both channels may be sampled simultaneously, phase differences can be measured very accuratly. Even single phenomena can be measured since each channel has a 32 Kbyte memory. Comprehensive software is provided. US $1098

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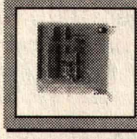

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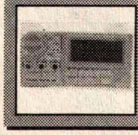

- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
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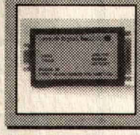
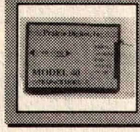
MODEL 45 .... $189



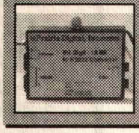
- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 40 .... $99



- RS-232 INTERFACE
- 28 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 .... $239



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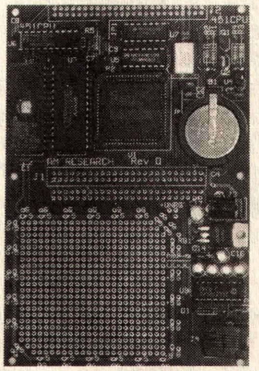

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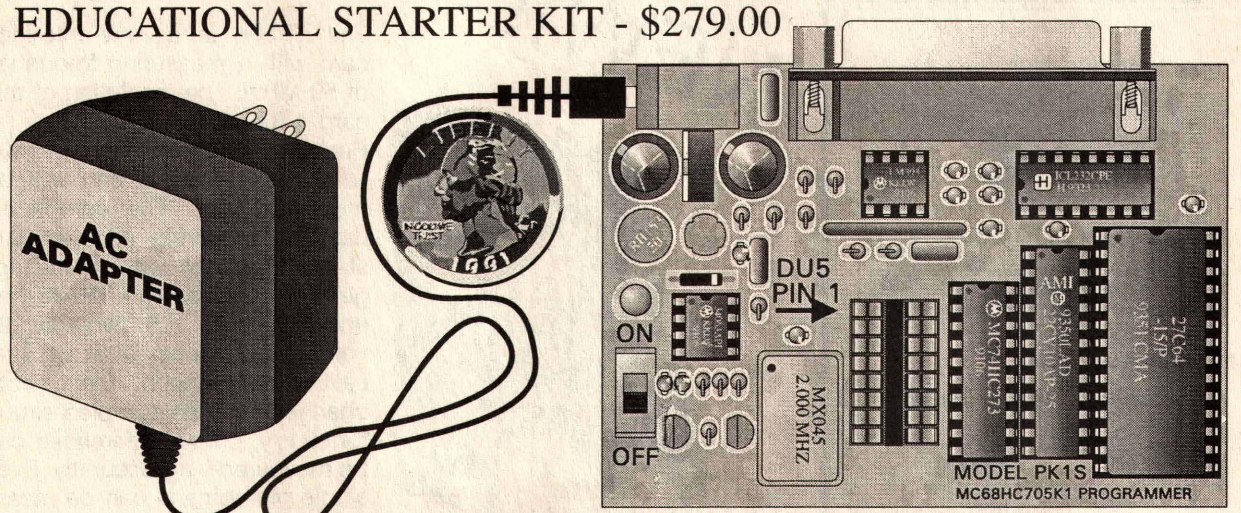

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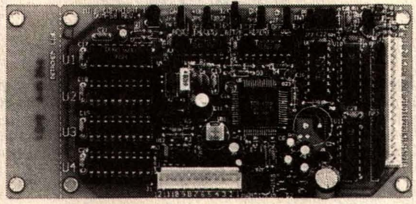

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The TX-99 interfaces with the TX-01 as the RF carrier module. 300 MHz AM with a typical range of 100' line-of-sight. (Key-chain transmitter is also available, model TX-99K $15.95)

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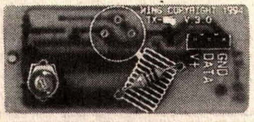
#MI-10-001E $9.95



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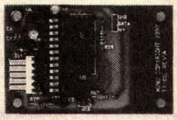


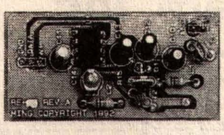
RF RECEIVER + DECODER MODULES

The RE-99 interfaces with the RE-01 as the RF carrier's receiver module and requires only a few solder connections to mate the two. 300 MHz AM.

#MI-10-9904 $6.95

The RE-01 Motherboard will decode a 12-bit address or 8-bit address with 4-bits of data, depending on which of the two included IC's is installed into the board.

#MI-10-001D $14.95



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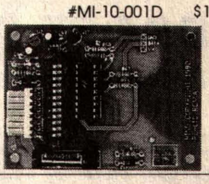
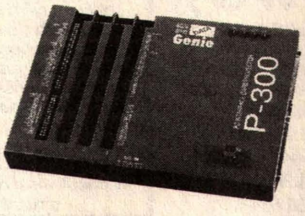


PC INTERFACE CARD PROTECTOR

The Data Genie P-300 is a device that allows quick and easy installation of add-on cards or prototype circuits for testing externally on your PC without having to turn off the computer. Maintains complete protection for your motherboard via the built-in protection circuitry & current limit fuses. Adds 3 expansion slots.



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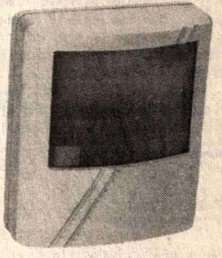

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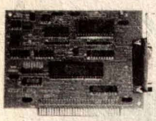
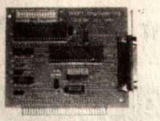


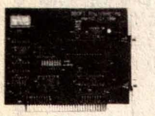
- 8 Channel 8-Bit 0 to 5 Volt input
- 14 TTL I/O lines
- Analog output
- 400 Khz sampling

DIG100 Digital I/O........... $ 39



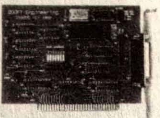
- 8255 PPI
- 24 or 48 TTL I/O Lines
- Selectable Base Address

ANA150 Analog/Counter... $ 89



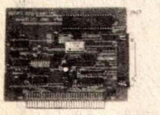
- 8 Channel 8-Bit 0 to 5 Volt input
- 3 16-Bit Counters
- 400 Khz sampling

DIG200 Counter I/O........ $ 79



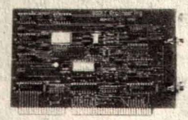
- 3 16-Bit Counters
- 8-Bit input port
- 8-Bit output port
- Selectable Clock frequency input

ANA200 Analog I/O............. $ 79



- 1 Channel 12-Bit 0 to 5 Volt input optional bi-polar
- 100 Khz sampling
- 24 TTL I/O lines

ANA201 Analog .... $ 129



- 8 Channel 12-Bit
- x1, x5, x10, x50 Programmable channel gain
- 100 Khz sample

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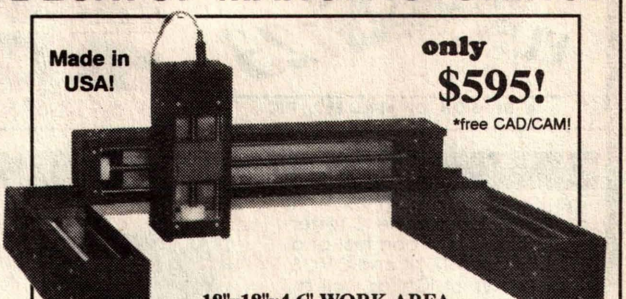

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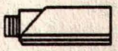

You've probably wished for a closed circuit camera/monitor system for your home or business. but those cost big bucks! Well. once again. Gateway comes to the rescue! We've got a 9" solid state video monitor with black and white camera and 10' interconnecting cable. Runs on 115 VAC. There is a microphone in the camera for one-way audio monitoring. and you can make cable runs up to 300 ft with twisted 3-pair wire. Requires 6 conductor round telephone cable and RJ-12 modular plugs. Why so cheap? The surplus market is an amazing place! We hook 'em up. make sure they get a picture from the camera to the monitor.(that's quality control!) and sell them to you at such-a-deal prices. Great for ATVers. business monitoring. and I-spy surveillence.

approx. dimensions : camera 2-1/2" x 4-1/4" x 8" monitor 8-1/2" x 8-1/2" x 9-3/8"

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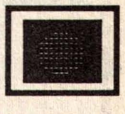
Optional matching case $14.95

ultra low-profilecamera with pinhole lens! $175.00



For the super-spy in all of us, here's the latest in little CCD cameras. It is about 1/2" thick and about one square inch (like those little crackers that are good for you!) It can be housed in almost anything due to it's small size. Requires 12 VDC and a little imagination. This camera is a tiny 1.3"x1.3"x 0.6", features a pinhole lense, a 0.4 lux 1/3 CCD sensor, 380 lines of resolution, and electronic shutter time of 1/100,000 sec. Whether you're spying on your mother-in-law or navigating your RC car, this is the ultimate in miniature surveillance.

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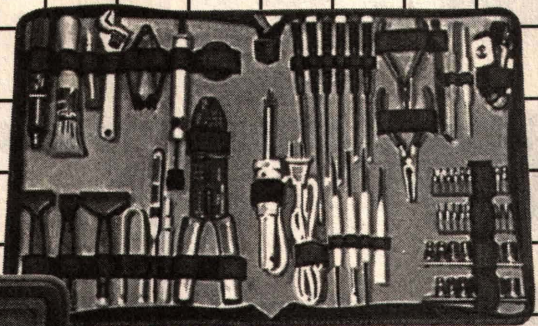

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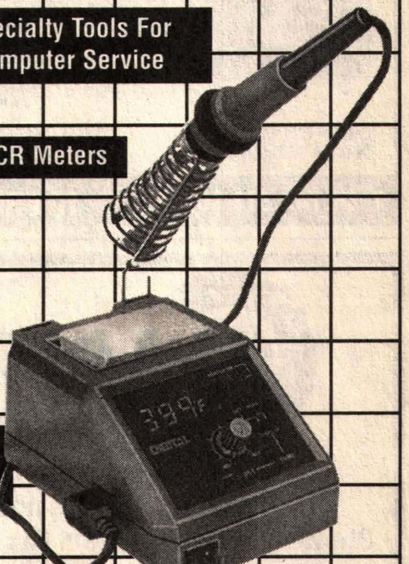

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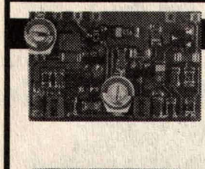

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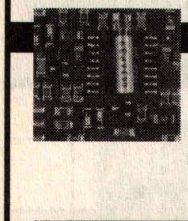

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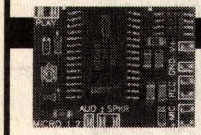

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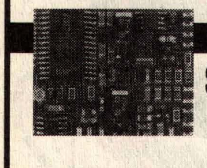

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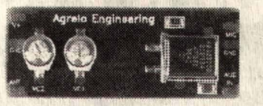

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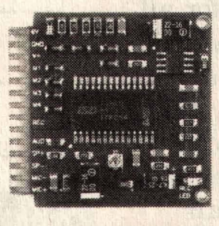

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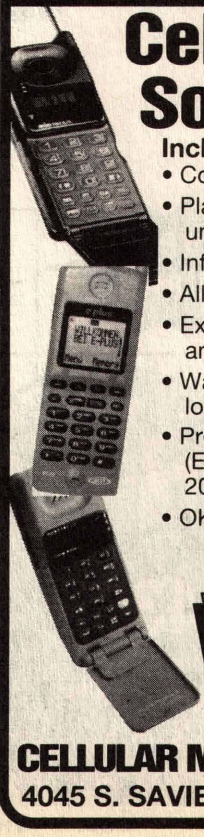

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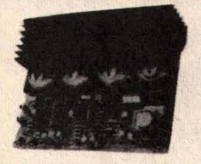
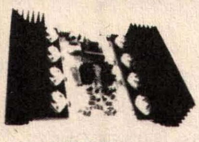
AF-2 ▲▲ 120-250W MOSFET POWER MONO AMPLIFIER (6 lbs.)



Kit:$ 89.80 Asmb$ 114.80

Power Output: 250W into 4 ohms RMS(42VX2 6A transformer is used). Frequency Response: 3-22,000HZ. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47K. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. Suggested Mark V model 012 transformer. Capacitor: 10,000uf 80V model 016. Suggested Metal Cabinet LG-1925.

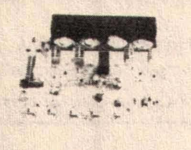
AF-3 ▲▲▲ 300W MOSFET HIGH POWER MONO AMPLIFIER (7 lbs.)



Kit: $ 165.00
Asmb.$ 195.00

Power Output: 300W into 4 ohms RMS. 200W into 8 ohms RMS. Frequency response: 10HZ-20KHZ.THD: < 0.03%. Signal to noise ratio:91dB. Input Sensitivity & Impedance at 1KHZ, 1V 47K. Load Impedance:4-16 ohms. Power Requirement: ±55 to ±65VDC 8A.Suggested Mark V model 009 Transformer. Capacitor 10,000uf 80V model 016. Recommended Metal Cabinet LG-1925.

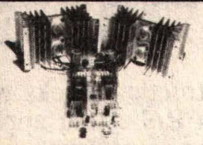
TA-800MK2 ▲▲ 120+120W PRE & MAIN STEREO AMP. (4 lbs.)



Kit:$ 67.92
Asmb.$ 86.95

Power Output:120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response:10-20KHZ. THD: <0.01%. Tone Control: Bass ±12dB, Mid & Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K. Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40VDC @ 6A. Suggested Mark V model 001 or 008 transformer. Recommended Metal Cabinet LG-1924.

TA-1000A ▲▲ 100W DYNAMIC CLASS A MONO AMP. (4 lbs.)

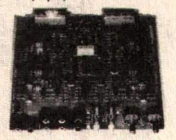


Kit:$ 54.00 Asmb.$ 74.00

Power Output: 100W into 8 ohms RMS, 125W into 4 ohms RMS. Frequency Response: 10HZ-100KHZ. THD: <0.008%. Signal to Noise Ratio:80dB. Sensitivity: 1V. Power Requirements: 35 to 45VDC @ 3A. Suggested Mark V model 001 or 008 transformer. Capacitor 10,000uf 80V model 016. Recommended Metal Cabinet LG-1924.

TA-388 ▲▲▲ CLASS A FET DYNAMIC BUFFER STEREO PRE-AMP. (1 lb.)

New

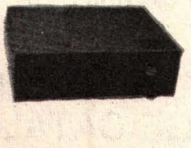


Kit:$64.00 Asmb.$ 80.00

Frequency Response (at rated output): Overall 10HZ-100KHZ +0.5dB-1dB. THD: Overall <0.007% at or below rated output level. Channel Separation (at rated output 1KHZ): Overall better than 70dB. Hum & Noise: Overall better than 90dB. Input Sensitivity (1KHZ for rated output): 300-600mV. Maximum Output Level: Pre-Amp output 1.8V (0.1% THD). Power Requirement: 30V X 2 AC 500mA.

SM-100 ▲▲▲ 150 MHZ 8 DIGIT FREQUENCY COUNTER (2 lbs.)

New Release



Kit:$ 79.00 Asmb.$ 99.00

Frequency Range: 10HZ-150MHZ. Gate Time: 0.01s, 0.1s, 1s, 10s. Input Sensitivity: KHZ range 10HZ-10MHZ 20mV(min.). MHZ range 1MHZ-120MHZ 20mV(min.), 120MHZ-150MHZ 35mV (min.), 150MHZ-200MHZ 40mV(typical). Time Base: 10MHZ crystal, ±10 ppm. Input Impedance: 1M ohm. Response Time: 0.2s. Resolution: 0.1 HZ: 10s gate time, 1HZ: 1s gate time, 10HZ: 0.1s gate time, 100 HZ: 0.01s gate time. Hold the last input signal. Reset counter to 0. DC 9V power adapter or 1.5VX4"D"size batteries.(Adapter not included)

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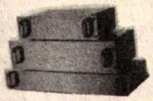

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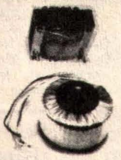

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**008	28/30V x 2	6A	40.00
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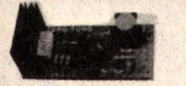
TY-2 ▲ FLUORESCENT LIGHT DRIVER



Kit:$ 14.75
Asmb.$ 20.50

This unit drives 6-40W fluorescent light for portable and emergency use. Works from a 7.2-16V DC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights. (1 lb.)

TR-503 ▲ REGULATED DC POWER SUPPLY

Kit:$ 18.75 Asmb.$ 27.65

It is short circuit proof and has overload protection. Output voltage is variable over a range of 0-50V. Current limit trip is adjustable up to max of 3A. Suggested Mark V 002 transformer. (1 lb.)

SM-302 ▲▲ 60+60W STEREO POWER AMP.

Kit:$ 75.00
Asmb.$ 94.00

It provides 3 input jack pairs. One pair accept a high impedance microphone. The two remaining pairs are for high & low level input sources. Power Output: 60W per channel into 4 ohms RMS. 20HZ-20KHZ. THD:<0.1%. Input Sensitivity: Mic/Guitar 10mV,Hi 380mV,Lo 640mV. Ready to plug in when assembled. (11 lbs.)

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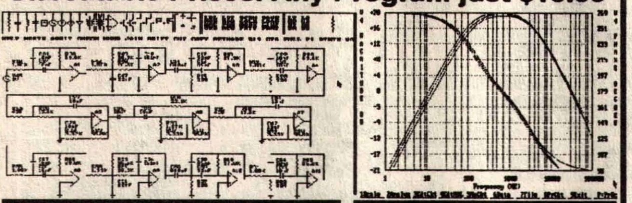

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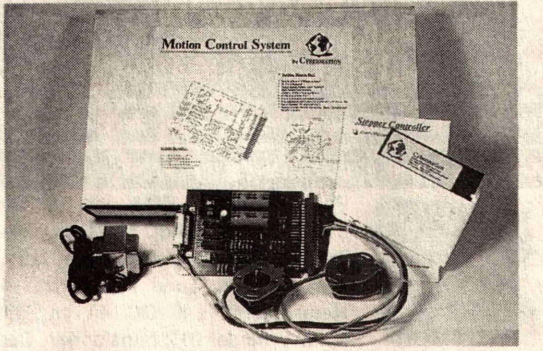

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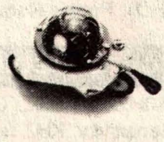

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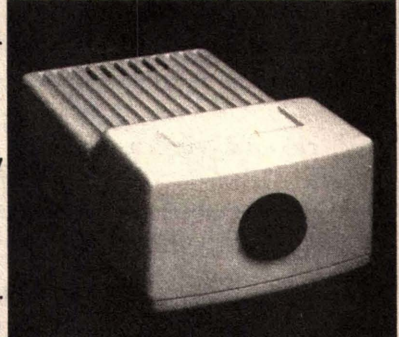

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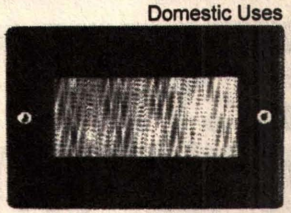

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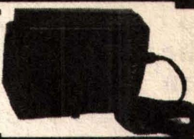

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22µF	.05	.045	.04
33µF	.06	.055	.05
47µF	.06	.055	.05
100µF	.08	.07	.05
220µF	.08	.07	.055
330µF	.09	.08	.06
470µF	.10	.09	.08
1000µF	.22	.20	.17
2200µF	.42	.40	.38
3300µF	.53	.50	.47
4700µF	.91	.87	.83
RAD. MONO 50V			
.001µF	.05	.045	.035
.0022µF	.05	.045	.035
.0047µF	.05	.045	.035
.01µF	.05	.045	.035
.022µF	.05	.045	.035
.047µF	.05	.045	.035
.1µF	.05	.045	.035
.22µF	.25	.22	.18
.47µF	.42	.35	.28
CERAMIC 50V			
5pF	.05	.038	.025
10pF	.05	.038	.025
18pF	.05	.038	.025
22pF	.05	.035	.025
27pF	.05	.038	.025
33pF	.05	.038	.025
47pF	.05	.038	.025
68pF	.05	.038	.025
82pF	.05	.038	.025
100pF	.05	.038	.025
120pF	.05	.038	.025
150pF	.05	.038	.025
180pF	.05	.038	.025
220pF	.05	.038	.025
270pF	.05	.038	.025
330pF	.05	.038	.025
470pF	.05	.038	.025
1000pF	.05	.038	.025
2200pF	.05	.038	.025
3300pF	.05	.038	.025
4700pF	.05	.038	.025
.01µF	.05	.038	.025
.022µF	.05	.04	.03
.047µF	.07	.055	.035
.1µF	.07	.058	.04
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1µF	.14	.11	.08
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4.7µF	.23	.185	.14
10µF	.28	.26	.22
22µF	.34	.27	.24
47µF	1.22	1.07	.94
AXIAL LYTIC 25VDC			
4.7µF	.09	.075	.054
10µF	.10	.08	.06
22µF	.14	.115	.084
47µF	.16	.13	.096
100µF	.19	.15	.11
220µF	.27	.215	.16
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1000µF	.45	.36	.27
2200µF	.89	.715	.54

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QTY	1	100	1000
1 AMP RECTIFIER			
1N4001	.03	.02	.015
1N4004	.04	.025	.019
1N4007	.05	.035	.022
3 AMP RECTIFIER			
1N5401	.06	.05	.042
1N5404	.07	.055	.045
1N5408	.08	.06	.049
6 AMP RECTIFIER			
6A10	.21	.185	.156
6A100	.32	.29	.25
1 AMP SCHOTTKY			
1N5817	.20	.145	.09
1N5818	.23	.165	.10
1N5819	.25	.18	.11
3 AMP SCHOTTKY			
1N5820	.34	.255	.17
1N5821	.38	.285	.19
1N5822	.42	.315	.21
GERMANIUM			
1N34A	.10	.08	.06
1N60	.10	.08	.06
1N270	.17	.15	.13
SWITCHING			
1N914	.035	.025	.015
1N4148	.025	.02	.01
1N4448	.035	.025	.015
1 W ZENER			
1N4728	.06	.054	.047
through			
1N4764	.06	.054	.047

INTEGRATED CIRCUITS

QTY	1	100	1000
PART #			
TIL111	.38	.34	.31
MC1458	.43	.36	.29
LM1488	.47	.43	.39
LM1489	.47	.43	.39
CD4001	.29	.25	.21
CD4011	.29	.25	.21
CD4013	.37	.33	.29
CD4017	.37	.33	.29
CD4025	.37	.33	.29
CD4028	.37	.33	.29
CD4040	.47	.43	.39
CD4049	.37	.33	.29
CD4051	.44	.40	.36
CD4066	.38	.34	.31
CD4069	.37	.33	.29
CD4093	.37	.33	.29
MOC3011	.40	.36	.32
LM311	.37	.33	.29
LM324	.47	.36	.25
LM339	.48	.37	.27
LM358	.48	.37	.27
LM386	.67	.49	.33
LM393	.37	.33	.29
4N25	.54	.39	.28
4N28	.58	.41	.34
LM555	.43	.38	.33
LM556	.47	.42	.38
LM741	.43	.38	.33
74LS244	.40	.36	.32
74LS245	.37	.33	.29
74LS374	.37	.33	.29

TRANSISTORS

QTY	1	100	1000
PART #			
2N2222A	.20	.18	.15
2N3055	.55	.50	.45
2N3904	.05	.045	.035
2N3906	.05	.045	.035
2N4124	.09	.07	.045
2N4125	.09	.07	.045
2N4126	.09	.07	.045
2N4401	.05	.045	.035
2N4403	.05	.045	.035
2N5086	.09	.07	.045
2N5087	.08	.06	.04
2N5088	.08	.06	.04
2N5089	.09	.07	.045
2N5209	.09	.07	.045
2N5210	.09	.07	.045
2N5400	.12	.10	.065
2N5550	.12	.10	.065
2N5551	.09	.07	.045
BU806	1.10	.80	.70
MJE3055T	.65	.55	.44
MPSA-05	.10	.08	.05
MPSA-10	.12	.09	.06
MPSA-13	.15	.11	.075
MPSA-14	.15	.11	.075
MPSA-42	.14	.105	.07
MPSA-44	.22	.18	.12
MPSA-56	.10	.08	.05
MPSA-63	.45	.34	.22
MPSA-92	.12	.09	.06
MPSA-93	.15	.11	.075
MPSH-10	.12	.09	.06
MPSH-81	.44	.33	.21
PN2222A	.05	.045	.035
PN2907A	.05	.045	.035
TIP30	.42	.37	.32
TIP31	.42	.37	.32
TIP41	.49	.44	.39
TIP112	.56	.51	.46
TIP122	.57	.52	.47
TIP125	.53	.48	.43
TIP126	.56	.51	.46

VOLTAGE REGULATORS

QTY	1	100	1000
PART #			
7805	.48	.45	.42
7812	.48	.45	.42
7824	.48	.45	.42
7905	.61	.55	.49
7912	.61	.55	.49
7924	.61	.55	.49
78L05	.35	.31	.26
78L12	.35	.31	.26
79L05	.35	.31	.26
79L12	.35	.31	.26
LM317T	.95	.82	.68
LM350T	2.05	1.70	1.35

CRYSTALS

QTY	1	100	1000
HC18 case			
1.8432	.89	.67	.45
2.0000	.74	.55	.39
3.5795	.74	.55	.39
3.6864	.74	.55	.39
4.0000	.74	.55	.39
4.9152	.74	.55	.39
5.0688	.74	.55	.39
7.3728	.74	.55	.39
10.000	.74	.55	.39
11.000	.74	.55	.39
11.059	.74	.55	.39
12.000	.74	.55	.39
14.3181	.74	.55	.39

frequencies are in MHZ

SWITCHES

QTY	1	100	1000
DIP STYLE			
4 POS.	.68	.58	.48
6 POS.	.77	.67	.57
8 POS.	.80	.70	.60
10 POS.	.95	.85	.75
TOGGLE			
SPDT	.62	.52	.40
SPDT-off	.73	.63	.49
DPDT	.69	.59	.46
DPDT-off	.86	.76	.59
PUSH BUTTON			
N. open	.28	.24	.20
N. closed	.29	.25	.21

All toggle and push button switches fit in a ¼" panel hole

LED's

QTY	1	100	1000
3MM			
RED	.06	.05	.04
GREEN	.07	.06	.045
YELLOW	.08	.07	.05
5MM			
RED	.06	.05	.04
GREEN	.07	.06	.045
YELLOW	.08	.07	.05
BI-COLOR	.29	.22	.17
BLUE	1.20	1.10	.95
BLINKER			
RED 5mm	.65	.53	.41
HOLDERS			
3mm	.10	.07	.055
5mm	.10	.07	.055

IC SOCKETS

QTY	1	100	1000
REGULAR			
8 PIN	.04	.035	.025
14 PIN	.08	.063	.045
16 PIN	.10	.08	.055
18 PIN	.11	.085	.06
20 PIN	.12	.095	.07
24 PIN	.15	.115	.08
28 PIN	.17	.13	.09
32 PIN	.20	.155	.11
40 PIN	.24	.185	.13
MACHINE			
8 PIN	.16	.135	.11
14 PIN	.28	.24	.185
16 PIN	.32	.27	.21
18 PIN	.36	.30	.235
20 PIN	.40	.33	.26
24 PIN	.48	.40	.32
28 PIN	.56	.47	.37
32 PIN	.64	.53	.42
40 PIN	.80	.66	.52
WIRE WRAP			
8 PIN	.32	.29	.26
14 PIN	.56	.51	.46
16 PIN	.64	.58	.52
18 PIN	.72	.66	.59
20 PIN	.80	.73	.65
24 PIN	.96	.87	.78
28 PIN	1.12	1.02	.91
32 PIN	1.28	1.16	1.04
40 PIN	1.60	1.45	1.30

BRIDGE RECTIFIER

QTY	1	100
IN LINE		
RS101 1A-50V	.60	.33
RS106 1A-800V	.93	.52
3N256 2A-400V	.95	.53
TL400 4A-50V	.65	.37
TU600 6A-50V	1.02	.65
TU800 8A-50V	1.33	.75
8 PIN DIP		
DF005M 1A-50V	.25	.18
DF10M 1A-1KV	.52	.33
ROUND		
W04M 1A-400V	.35	.17
2W10M 2A-1KV	.50	.27
SQUARE WIRE LEADS		
TB305 3A-50V	.53	.30
TB805 8A-50V	.93	.52
SQUARE TAB LEADS		
TB151 15A-100V	2.30	1.35
TB352 35A-200V	2.68	1.50

special pricing available for quantity over 500pcs.

CABLE TIES

NATURAL COLOR

QTY	100	1000	5000
4" LENGHT	2.00	7.00	30.00
8" LENGHT	4.00	25.00	98.00

1Lb SOLDER ROLL

.031" diameter

SN60/40

$6.50 each

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ANY STANDARD VALUE

QTY	50	1000	5000
¼ W 5%	.80	7.00	28.00

These are prices for total quantity of same value. No mixing.

D-SUB CONNECTORS

QTY	1	100	1000
SOLDER CUP			
DB9 m.	.29	.22	.15
DB9 f.	.29	.22	.15
DB15 m.	.35	.27	.19
DB15 f.	.37	.29	.21
DB25 m.	.53	.37	.21
DB25 f.	.57	.42	.26
RIGHT ANGLE			
DB-9 m.	.49	.39	.30
DB-9 f.	.49	.39	.30
DB15 m.	.54	.44	.33
DB15 f.	.54	.44	.33
DB-25 m.	.69	.54	.49
DB-25 f.	.69	.54	.39
PLASTIC HOOD FOR DB			
DB-09	.26	.195	.13
DB-15	.29	.24	.19
DB-25	.31	.26	.21
DB-37	.53	.43	.34

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SLC2-66		260.00
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DX2-50	128K	351.00
DX2-66	256K	416.00
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PCI 90 MHZ		1,375.00

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VESA 2MB	195.00

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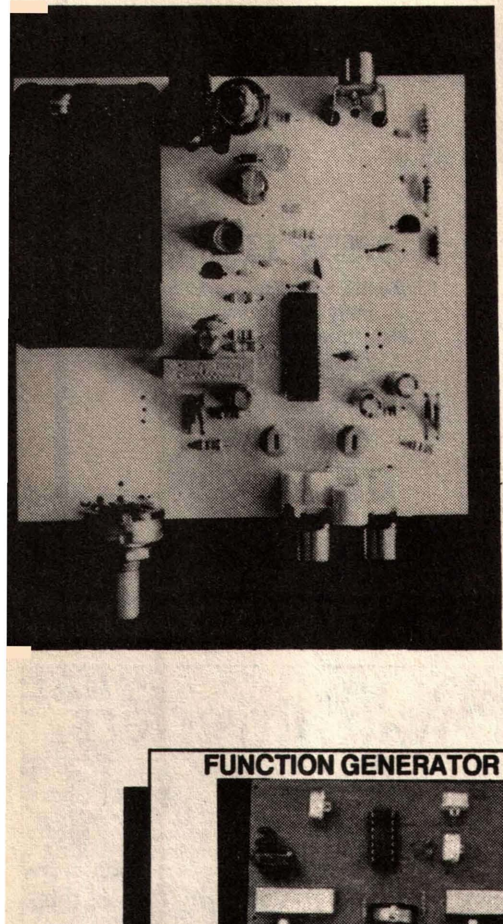

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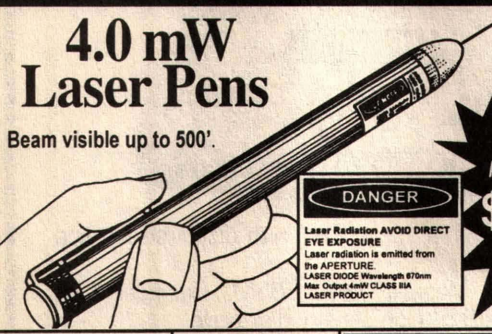
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Laser Radiation AVOID DIRECT EYE EXPOSURE
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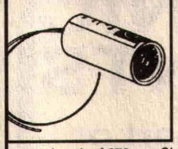

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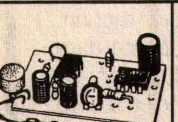

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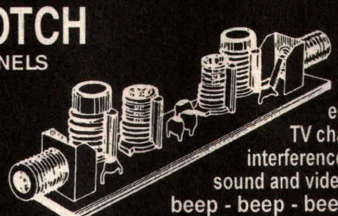
TV NOTCH

FOR CHANNELS
2 thru 22



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep - beep - beep.

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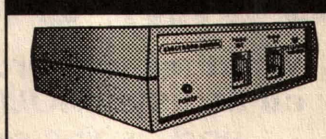
DF-222 Kit **$14.95**

The Exciting New TELEPHONE MONITOR



Monitors your phone system, See how accurate your phone company really is!

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   - Length of the call.
   - What number was dialed.
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   - Date & time of call.
   - How many times phone rings.
   - If answered the length of call.
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EASY TO INSTALL

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All software included!

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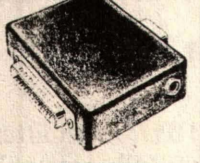
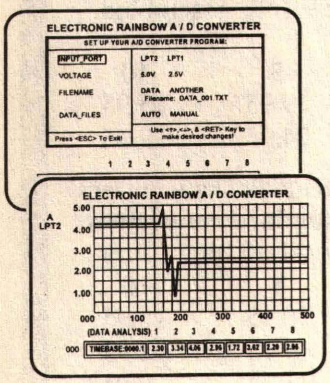
8 CHANNEL A to D CONVERTER KIT

Complete with Software. Over 20 DOS programs provided!





ELECTRONIC RAINBOW A / D CONVERTER

SET UP YOUR A/D CONVERTER PROGRAM:

INPUT_PORT	LPT2 LPT1
VOLTAGE	5.0V 2.5V
FILENAME	DATA ANOTHER Filename: DATA_001 TXT
DATA_FILES	AUTO MANUAL
Press <ESC> To Exit!	Use <↑>,<↓>, & <RET> Key to make desired changes!

1 2 3 4 5 6 7 8

ELECTRONIC RAINBOW A / D CONVERTER

(DATA ANALYSIS) 1 2 3 4 5 6 7 8

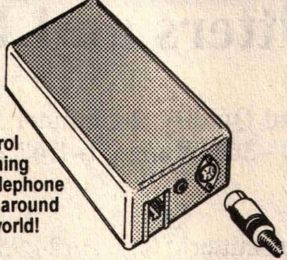
000	TIMEBASE:0000.1	2.30	3.34	4.06	2.96	1.72	3.62	2.20	2.96

- Connect your computer to the outside world through a parallel port!
- Monitor eight sperate 8 bit analog inputs simultaneously and display them digitally or graphically.
- Use your computer as an oscilloscope using the provided DOS software!
- Hardware selectable 0-2.5 VDC or 0-5 VDC input range. Chart provided to calculate scaling resistors (resistors not included).

SIZE: 3"x2.5"x1" case. Mates to parallel port on back of PC.

AD-8 KIT **$89.95**
BUILT **$109.95**

16 DIGIT DTMF DECODER



Control anything by telephone from around the world!

Enter a code (Code can be any number up to 16 digits) **and control....**

- Turn lights on while on vacation.
- Start your furnace or air before you go home.
- Switch your incoming line to a fax.
- Make your phone so it will not call to a long distance or a 900 number.
- Connect this unit to the AA-1 kit and listen to anything in the room.

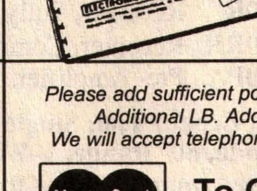
Requires an answering machine to function.

DTMF-1 KIT **$74.95**
BUILT **$99.95**

WIRELESS FM MICROPHONE

Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. SIZE: .8"x1" 6 to 12vDC

WM-2 **$14.95**



This Manual contains schematics, parts lists, P.C.B., layouts for many of the Rainbow Kits. Use your own parts to construct our kits.

KIT BOOK
$14.95

$9.95 with the purchase of any kit.

FM STEREO TRANSMITTER

Own your own FM radio station. Any stereo signal you plug into the FMST-100 will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Transmit a wireless link through an auditorium, from your car to your camper, listen to your cd's while mowing the lawn,Play music on one channel sing on the other. Clarity is excellent, aprox. 40dB stereo separation. Length of antenna determines the distance of transmission. Complete with stereo input level controls, & crystal for stereo separation. 9v battery operation

FMST-100 **$29.95** / FMSTC cabinet **$8.95**

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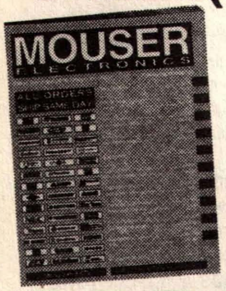

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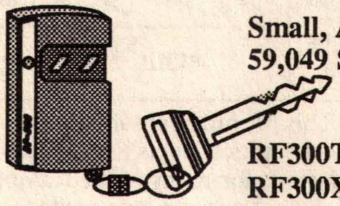
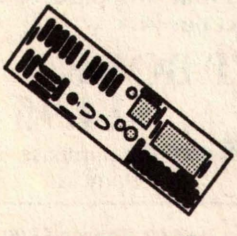
Miniature Transmitters and Receivers



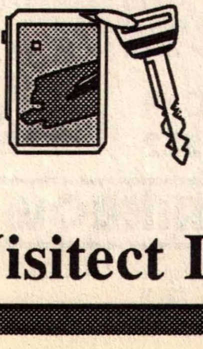
Small, Attractive, High End Quality, 2 Channel 318 MHz Transmitter
59,049 Settable Codes, 120'–300' Range, 1–1/4" x 2" x 9/16", Assembled

	Qty	1	5	10
RF300T	150' Range Transmitter	24.95	19.95	15.95
RF300XT	300' Range Transmitter	29.95	24.95	19.95



Small, High End Quality, 2 Channel Receiver for the RF300 Transmitters
1–1/4" x 3–3/4" x 9/16" PCB w/ .1" spaced pads for standard connectors
Input: 8–24 vdc Output: Gated CMOS Momentary and Latching Lines

	Qty	1	5	10
RF300R	Receiver, Fully Assembled	24.95	20.95	16.95
RF300RK	Receiver, Complete Parts Kit	19.95	15.95	12.95
RF300PA	Pre–Amplifier. Doubles Range	14.95	11.95	9.95



Small, Economical, Single Channel Transmitter and Receiver Set
Set Code, 60' Range, 1–7/8"x2–3/8"x7/16" (T), 2"x2–3/4"x9/16" (R)
Receiver Input: 5 vdc Output: Gated TTL Momentary Line

	Qty	1	5	10
RF60	Transmitter and Receiver Set	24.95	19.95	14.95

Add $ 4 shipping for first item + $ 1 for each additional item. Ca. residents add 8.25% tax
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BGC- 8088 or IBM PC/compatible.

BGC-8088 only $699.00 **8088µp Trainer &Tool.**

Features: Assembly language coding, assembler, disassembler, single step and multi-breakpoint program debugger, display and rewrite registers, download/upload programs from/to external systems, I/O drivers, 56-key large size keyboard, LCD display, RS-232, UART, printer interface, two expansion slots, ±5V, ±12V switching power supply, user's guide and experiment guide, Practical control applications available, such as servo and stepping motor, dot matrix display, D/A, A/D, sensors, ...

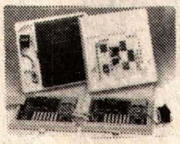
EDS-8811 $289.00 E(E)PROM programmer for

See us at ITEA '95 Conference , Booth #824.

BGC-8052 $979.00 It helps you learn the most powerful and popular Intel 8051/8052 Embedded Microcontroller in today's appliance control. **Learning guide and experiment examples included.**

U-DBGR $1599.00 Universal Debugger/In-circuit Emulator for commonly used Microprocessors, such as 6502, Z80, MCS-48, MCS-51, 8088, .. etc.. Trace & debug program, EPROM programmer, DOS Shell. Can be operated with BGC-8088 or IBM PC/compatible. **Speed up your development.**

APEX-IE 8052 $699.00 In-Circuit Emulation Systems for 8051/8052. It helps you understand microprocessor based control circuit design, troubleshooting, assembly language programming and debugging. Can be operated on BGC-8088 or IBM PC/compatible. Speed up your product design.



CIC-100 $549.00 IBM PC/compatible I/O control applications, learn Assembly, C, and BASIC programming languages, 800-pin solderless breadboard for circuit design andtest, I/O drivers for controlling relay, step motor, LED, speaker, sensor, ..etc.. Experiment manual. Application control modules available, including step motor, matrix keypad, traffic light, A/D, D/A, F/V, V/F converters, sensors, etc.

EDS-8809-1 $589.00 IBM PC/compatible(add an adapter $99.00) and BGC-8088 I/O control applications include 24 experiments, such as stepper motor control and simulation, digital clock, speaker control, dot matrix LED control , Matrix keyboard, sign lights, 8255 polling handshakes, electric piano, stop watch,.. more.

EDS-8804 $239.00 A/D and D/A converter applications for BGC-8088 or IBM PC/compatible.

EDS-8805 $479.00 Servo motor and stepper motor control for BGC-8088 or IBM PC/compatible.

DC POWER SUPPLY

PS-303 $159.00
0-30VDC, 0-3A; 0.02%+2mV line regulation; 0.02%+3mV load regulation; 1mVrms noise & ripple; Short circuit/overload protection; constant current/voltage(CC/CV).

PS-303D $314.95 dual outputs.

PS-305 $219.95, 0-30VDC, 0-5A.

PS-305D $399.95, dual outputs, over load protection.

8110 $289.95
0-60VDC, 0-3A.

8112 $399.95
0-60VDC, 0-5A.

8108(8109) $549.95($699.95)
dual output, 0-60VDC, 0-3A(5A), independent tracking operation. Low ripple.

8102(8103) $399.95($489.95) dual 0-30VDC/0-3A(5A), fixed 5VDC/3A, indepedent tracking operation, constant voltage and current. Slave/Master, Serial/Parallel connection.

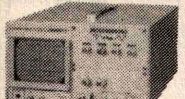
PS-1610S(8107) $289.00($399.95) 0-16VDC, 0-10A.

PS-2243(2245) $139.00($159.00) 0-12/0-24VDC,3A(5A).

8200(8201) $179.95($239.95) 0-30VDC(digital meter), 0-3A(5A). **8210(8211) $209.95($269.95) two digital meters.**

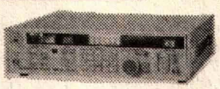
8202(8203) $499.95($549.95) 3 outputs, digital display, dual 0-30VDC/0-3A(5A), a fixed 5VDC/3A, indepedent tracking operation, constant voltage and current.

AM/FM SWEEMAR SCOPE



SM-6225B/C $1999.95
Freq Range: (AM)490KHz; (FM) 10-11.4MHz; *Acuracy*: ± 0.1%
Marker: (AM)455KHz, ±5KHz, ±10KHz; (FM)10.7MHz, ±7.5KHz, ±150KHz.

AM/FM STD SIGNAL GEN.

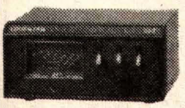


SG-4110A $1799.00
Freq: 100KHz-110MHz
Display: 6-digit LED
Accuracy:
<±(5x10-E5 ±1 count)
Resolution:100Hz (100-34.99MHz); 1KHz (35MHz-110MHz).
Output Range: -19dBu, -99dBu, 1dB step
Impedence: 50 Ohm VSWR 1.2.

TV COLOR PATTERN GEN.

CPG-1366A $159.95
VHF NTSC;
Freq.: 45.75, 175.25, 187.25 MHz;
RF Output: 10mV.
Impedence: 75 Ohm;
Video Output: BNC, 1Vp-p

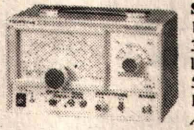
SWR/RF POWER METER



310 $89.95
Freq.Range: 1.8-150MHz.
RF Power: 0-4W/20W/200W
SWR Measure.: 1.0 - ∞, 4W min.
Accurcy: 5%-10%; SO-239 plugs.
Insertion Loss: O.3dB.
Input/Output Imp.: 50Ω.

320 $89.95, 130-520MHz.
330 $119.95, 1.8-520MHz.
SWR-3P $26.95 1.7-150MHz;
RF Power: 0.5-10W, 0.5W-100W.
SWR-2P $22.95, 1.7-30MHz; *RF Power*: 0.5-10W.
PM-330 $136.00 1.8-500MHz; 0-5W/20W/120W.

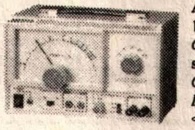
RF SIGNAL GENERATOR



SG-4160B $119.00
100KHz-150MHz up to 450MHz on 3rd harmonics; 6 ranges; AM modulation. *RF Output*: 100mVrms to 3-5MHz. *Modulation*: Int. 1KHz AM, Ext. 50Hz-20KHz AM.
Audio Output: 1KHz, 1Vrms.

SG-4162AD $229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals.

AUDIO GENERATOR



AG-2601A $119.00
10Hz-1MHz, 5 ranges;
Output Level: sinewave 0-8Vrms, square 10Vp-p.
Output Impedence: 600 Ohm.
Distortion: <0.05% 500Hz-50KHz; <0.5% 50KHz-500KHz.

AG-2603AD $229.95, with Freq. Counter 1Hz-150MHz, 6 digits, for internal & external signals.

FUNCTION GENERATOR

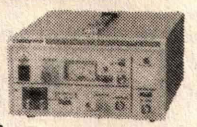
FG-2100A $169.95
0.2Hz-2MHz in 7 ranges; Sine, Square, Triangle, Pulse & Ramp
Output: 5mVp-p-20Vp-p, 1% distortion.
VCF: 0-10V control freq. to 1000:1.

FG-2102AD $229.95 generates signals same as FG-2100; 4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy.

FG-2020B $159.00 0.5Hz-500KHz; Sine, Square, Triangle.

(FG)2103 $329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges. *Operating Mode*: sweep, AM, gated burst, VCG.
Freq. Counter: Int. 0.5Hz-5MHz; Ext. 5HZ-10MHz

FM STEREO MODULATOR



AG-2011A $549.00
RF SECTION:
Carrier: 98MHz ±2MHz;
Output: 10mV, 1mV & 0.1mV
COMPOSITE SIGNALS:
Pilot: 19KHz ±2Hz, 0.8Vrms
INT. MODULATION: 400KHz, 1KHz ±1%, 1Vrms, distortion < .5%; *L-R Seperation*: >50dB.
EXT. MODULATION: *Freq.*: 50Hz-15KHz
L-R Seperation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz..

AC MILLIVOLT METER

MV-3100A $159.95 wide band 5Hz~1MHz; 3 scales, mV, dB, &dBm; 300µV~100V in 12 ranges, 10µV resolution; -70~40dB in 12 ranges, 0dB=1Vrms, 0dBm=0.755V); ±3% accuracy; Input impedence 10MΩ; Noise <2%.

MV-3201B $309.95 dual channels, simultaneous measurement..

OSCILLOSCOPE

OS-7305B $249.00 DC~7MHz;

Vertical: 10mV/Div; Horizontal: 250mV/Div; 10Hz~100KHz in 4 ranges; 3" CRT;Internal and External Sync.; Input: 1MΩ/35pF.

OS-7010A $369.00 DC~10MHz. 5" CRT, 10mV/Cm~10V/Cm, 1MΩ.

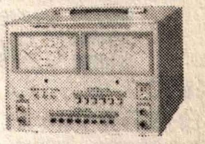
OS 622B$344.95 20MHz/dual trace.

OS-7001A $369.00 Aligment Scope. DC~200KHz, 5" CRT.

GRID DIP METER

DM-4061 $89.95 1.5-250MHz, 6 bands;6 plug-in coils, 2 transistor, and 1 diode.
Modulation: ≈ 2KHz Sinewave. *Crystal Oscillator*: 1-15MHz. Wave absorption meter. Using 9VDCpower supply.

AUTO DISTORTION METER



DM-3104A $799.95
MEASUREMENT:
Range: 0.01%-30%, 0.1/0.3/1/3/10/30% full scale.
Freq.: 400Hz±10%, 1000Hz±10%(HPF).
Input: 3mV-100V, ratio measuring 20dB.
Auto. Switching Ranges: Fundamental Freq. = (fo)±10%;
Fund. Rejection: >-80dB at (fo)±5%; >-70dB at (fo)±10%.
Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.

DM-3204 $1,599.00 dual channels.

FREQUENCY COUNTER

FC-5250C $119.95
Freq. Range: 10Hz-220MHz: (HF)10Hz-20MHz, (VHF)10MHz-200MHz
Gate Time: 0.1 & 1sec.
Max. Input: 10Vp-p.
Input Sensitivity: 35mV 10Hz-200MHz.
Input Imped.: (HF) 1MOhm, (VHF) 50Ohm.

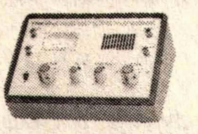
FC-5260A $146.00
10Hz-600MHz.

FC-5270A $149.95
10Hz-1300MHz.

FC-5600B $321.00
10Hz-600MHz.

(FC)5700B $329.95 10Hz ~ 1.3GHz.

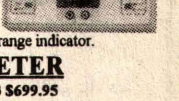
SIGNAL TRACER/INJECTOR



SE-6100 $134.95
TRACER: Gain Max. 60dB
Attenuation: 0/20/40/60dB
Input Imped.: 100KOhm
Output Imped.: 600Ohm;
Speaker: 8 Ohm.
INJECTOR: *Freq.*: 1KHz Squarewave; *Output Level*: Continuously variable 0 - 4.5Vp-p.

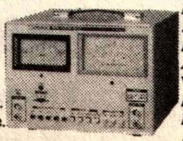
AUTO. CAPACITANCE METER

CM3300A $139.00 10 ranges, 99.9pF ~ 99.9mF, fully automatic.



Resolution: 0.1pF lowest, 0.1% full scale.
Accuracy:
0.5% of full scale±1digit to 99.9µF,
1% of full scale±1digit to 99.9µF.
Display: 3 digit LED.
Unit indicator: pF, nF, µF, mF. Overrange indicator.

WOW-FLUTTER METER



WF-3103 $699.95
Freq. Range: 3KHz±10% JIS/CCIR; 3.15KHz±10% DIN.
Range: 0.03/.1/.3/3% full scale.
Accuracy: ±5%.

WF-3105A $799.95, digital;
Function: LIN/WOW/Flutter/WTD.
Freq Cntr: 10Hz-9.99MHz.
Indication: CCIR/DIN/JIS.

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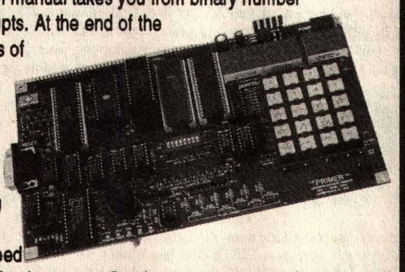

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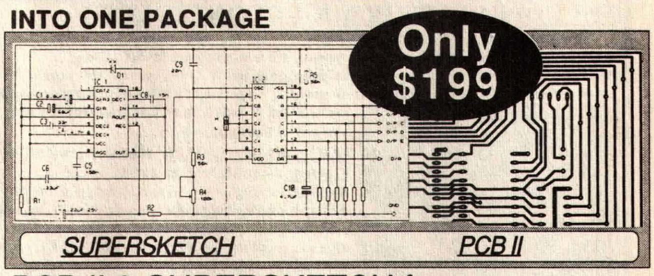

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* OUTPUT TO 9 & 24 PIN PRINTERS, HP LASERJET& HPGL PLOTTERS * OUTPUT TO DTP PACKAGES *
* PCB II ALSO HAS GERBER OUTPUT & VIEWING. *

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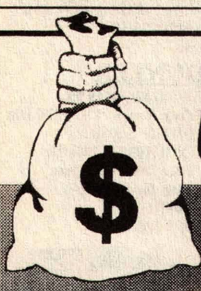

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COAXIAL & WAVEGUIDE

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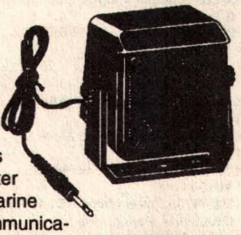

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CAT # LCAC-36

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6' BLACK 18/3 IEC female one end, standard grounded three prong male on other end.

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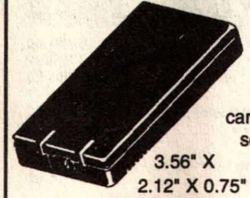

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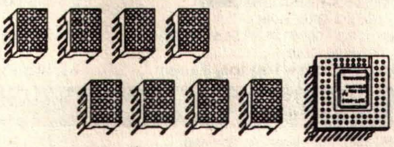

Hewlett Packard# HDSP-L203

Eight 5 X 7, 0.68" high LED dot matrix displays along with one PGA-type smart driver. The driver can decode 128 ASCII characters which are permanently stored in ROM. In addition, 16 programmable symbols may be stored in on-board RAM. The IC is designed for standard microprocessor interface techniques and is accessed through a bi-directional eight-bit data bus. Operates on 5 Vdc. Spec./hook-up sheets included.

CAT# AND-203L **$7.50 each**

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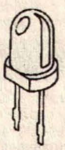

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5 for $1.00

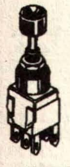
CAT# LED-23

100 for $ 15.00

1000 for $ 120.00

MOISTURE RESISTANT D.P.D.T SWITCH

REDUCED PRICE !



Augat/Alcoswitch # MPE206N Miniature DPDT, push/on push/off switch. Splashproof: O-ring on shoulder and inside movable shaft provides moisture seal. Rated 6 amps @ 125 Vac. RED 0.4" dia. cap. 0.25" diameter threaded bushing. 0.8" behind panel depth. Solder lug terminals. UL and CSA listed.

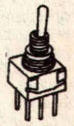
CAT # MPB-20

$1.75 each

25 for $37.50 ($1.50 each)

MINIATURE TOGGLE

D.P.D.T. (ON-ON)



ALCOSWITCH # MTM206NPC

Short bat handle, 0.25" long.

PC terminals.

CAT# MTS-82PC **$1.25 each**

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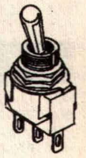
S.P.D.T. (ON-OFF-ON) MOMENTARY ONE DIRECTION



ALCOSWITCH # MTG106H

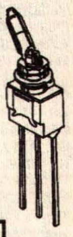
Standard toggle handle and 15/32" diameter bushing with miniature body. Rated 5 amps @ 125 vac. Center-off, momentary "on" in one direction.

CAT# STS-41

$1.50 each

25 for $ 31.25

S.P.D.T (ON-ON) LOCKING TOGGLE



ALCOSWITCH #AL0LKWB

Locking toggle handle prevents accidental switching.

Wirewrap pins.

CAT # MTS-43

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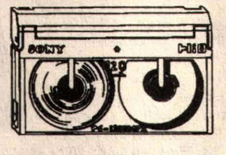
"HI-8" VIDEO CASSETTE (USED)

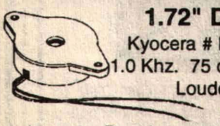


SONY Hi-8 T-120 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased, each cassette has its own plastic storage box. Satisfaction Guaranteed.

CAT# VCU-8 **$3.00 each**

10 for $28.00 • 100 for $250.00

PLASTIC ENCASED PIEZO ELEMENT



1.72" DIA. X 0.53"

Kyocera # KBT-44SB-1A

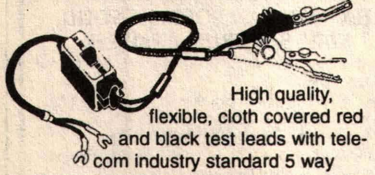
1.0 Khz. 75 db min. @ 10 V p-p

Louder than non-encased piezo elements. Requires an external signal to produce a sound.

CAT# PE-26 **75¢ each**

10 for $6.50 • 100 for $50.00

5 WAY MULTI-POINT TEST LEADS

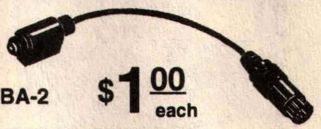


High quality, flexible, cloth covered red and black test leads with telecom industry standard 5 way multipoint test clips on one end and spade lugs on the other end. 5 ways to connect clips: 1) U-shaped nose for qc terminals; 2) Notched jaw for gripping screws, wires or terminals; 3) Serrated teeth for threaded or wire wrap terminals; 4) Cluster of small needles for piercing small gauge wires; 5) Large piercing needle for piercing larger wires. 4 feet long. At one end of the cord is a 1500 ohm resistor that can be switched in and out of circuit.

CAT# TL-200 **$3.50 per set**

KEYBOARD ADAPTERS & CABLES

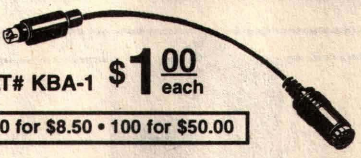
DIN 5 FEMALE TO MINI-DIN 6 MALE



CAT# KBA-2 **$1.00 each**

10 for $8.50 • 100 for $50.00

DIN 5 MALE TO MINI-DIN 6 FEMALE



CAT# KBA-1 **$1.00 each**

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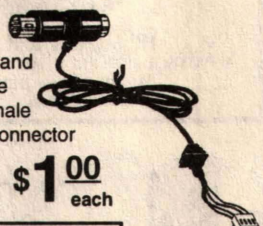
COMPUTER KEYBOARD CABLE/ADAPTER

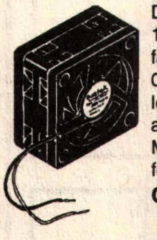


4' four conductor cable with 4 pin socket connector and strain relief on one end and a 5 pin male and female DIN connector on the other end.

CAT# KBA-3 **$1.00 each**

10 for $8.50 • 100 for $50.00

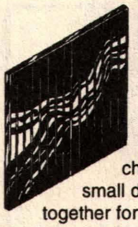
MINI 12 Vdc COOLING FAN



Delta "Quietek" # SB0412M 12 Vdc, 0.12 amp mini cooling fan. 0.57" (40mm) square X 0.79" thick. 12" long pigtail leads. Ideal for cooling CPUs and small switching supplies. Moves a lot of air for its size.

CAT# CF-22 **$7.50 each**

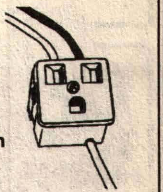
9 VOLT 60 MA SOLAR PANEL



These 6" X 6" glass enclosed photovoltaic panels produce 9 Vdc at 60 ma. Ideal for charging batteries and powering small devices. Put two or more together for more current and voltage. Includes hook-up instructions.

CAT # SPL-960 **$5.25 each**

15 AMP GROUNDED RECEPTACLE

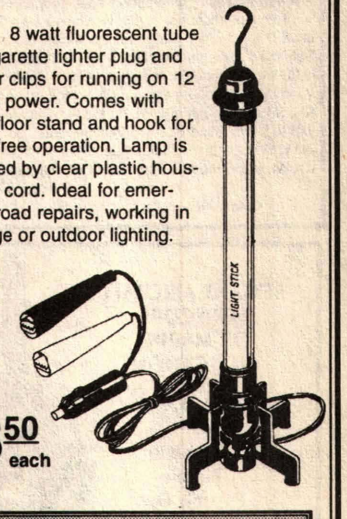


3 prong grounded AC outlet. Snaps into 1" square hole. Rated 15 amps @ 125 Vac. 6" long pigtails. Black. UL and CSA listed.

CAT# ACS-1 **$1.00 each**

10 for $9.00

12 VOLT FLUORESCENT LIGHT STICK



12 volt, 8 watt fluorescent tube with cigarette lighter plug and alligator clips for running on 12 volt DC power. Comes with handy floor stand and hook for hands free operation. Lamp is protected by clear plastic housing. 15' cord. Ideal for emergency road repairs, working in a garage or outdoor lighting.

CAT # FL-1 **$8.50 each**

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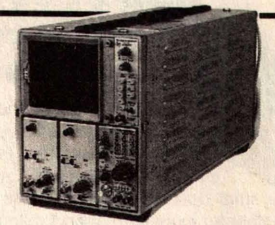
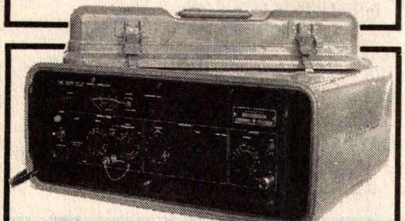


TEK MODEL 7603N

Oscilloscope: Mil Spec AN/USM-281C, 8 × 10 CM display, 100 mHz response which accepts standard 7000 series Plug-Ins. Vertical Plug-In: 2 ea. 7A15 (AM-6565), frequency BW 75 mHz, maximum sensitivity 5mV/DIV. Horizontal Plug-In: 1 ea. 7B53 (TD-1085), triggering to 100 mHz, minimum, sweeptime 50 NS/DIV, has delayed sweep capacity. Includes cover probes accessories. **Price: $495.00**



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(w/o synchronizer) Frequency range: 450 KHz to 512 MHz, to 1100 Mhz with external frequency doubler option supplied. Ten Frequency bands in octave increments from 500 KHz; band 11 for doubler use. Accuracy: 6 digit LED read out. Stability: < 1000 ppm. Output power: −145 dBm to +10 dBm (0.013 V to 2 V) into 50 Ω. Impedance is 50 Ω, VSWR < 2.0 on 2 V and 1 V range < 1.3 on other ranges >. Modulation: Internal AM, FM and PM, external AM, FM and PM. Pulse frequency: 0.05 to 5 kHz. General: Power Requirements: 100, 120, 220, 240 V, 48 hz to 420 hz, 2 amps. Size: 6" (H) × 19" (W) × 13¼" (D). Wt. 60 lbs. Includes ruggedized case and manual.

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TEK453 MODEL 453

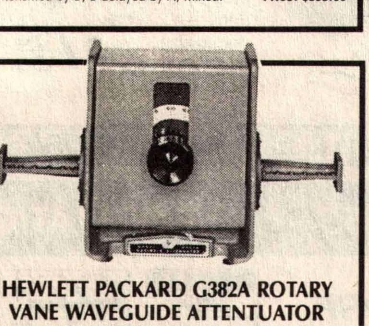
Oscilloscope: Portable, dual trace unit, DC to 50 MHz with 5 mV/div sensitivity. 1 usec to 5 sec/div timebase plus delay sweep. 6 × 10 div CRT **Price: $295.00**

HP MODEL 200CD

AUDIO OSCILLATOR: 5 HZ TO 600 HZ, IN 5 RANGES, 10 VOLTS INTO 600 OHMS
PRICE: $95.00

TEKTRONIX 465M 100 MHz DUAL TRACE OSCILLOSCOPE

Operation is simplified by single-function push buttons, control knob design, layout and color-coordinated front panels. Bandwidth: DC to 100 MHz; Deflection Ranges: 5mV/div. to 5 V.div; 0.5 S/div. to 0.05 µS/div. sweep rate; horizontal display modes: A, A intensified by B, B delayed by A, mixed. **Price: $395.00**



HEWLETT PACKARD G382A ROTARY VANE WAVEGUIDE ATTENTUATOR

Frequency: 3/95 to 5.85 GHz. Attentuation: 0 to 50 db. Connector: WR187/UG407U waveguide. **Price: $395.00**

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Frequency range: 2MHZ to 1000MHZ. **Power range:** 10 Watts to 1000 Watts. USWR≤ 1.08 to 1. Uses three plug-in coupler elements, (included). CU-753 2 to 30 MHZ 50 to 100 Watts CU-754 25 to 250 MHZ 10 to 500 Watts CU-755 200 to 1000 MHZ 10 to 500 Watts **Connector:** Type N. Case included. **Size:** 7"W × 6⅝"H × 7⅕"D **Weight:** 6.5 lbs. **Price: $245.00**

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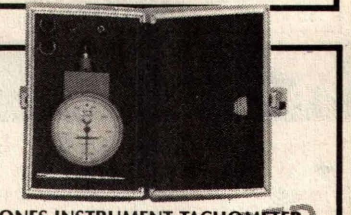

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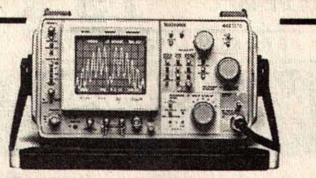

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Built-in RF Preselection (Option 1)
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CRT read out of display parameters. Dynamic range (on screen) 80db. CRT size: 8 × 10 cm. Resolution Bandwidth: 1MHZ to 1KHZ (100 HZ-Option 3). Power: 210 watts, 115V/60HZ. Weight: 44lbs. Size: 6.9" × 12.9" × 19.7". **Price: $7,650.00 Option 1,2,3**
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Model 333A Distortion Analyzer: Covers 5Hz t6o 600 kHz range. Measures down to 0.1% full-scale distoertion. Includes aluto nulling feature to speed up time consuming portion of measurements. Also includes switchable high-pass filter to attenuate frequencies below components. **Price: $400.00**

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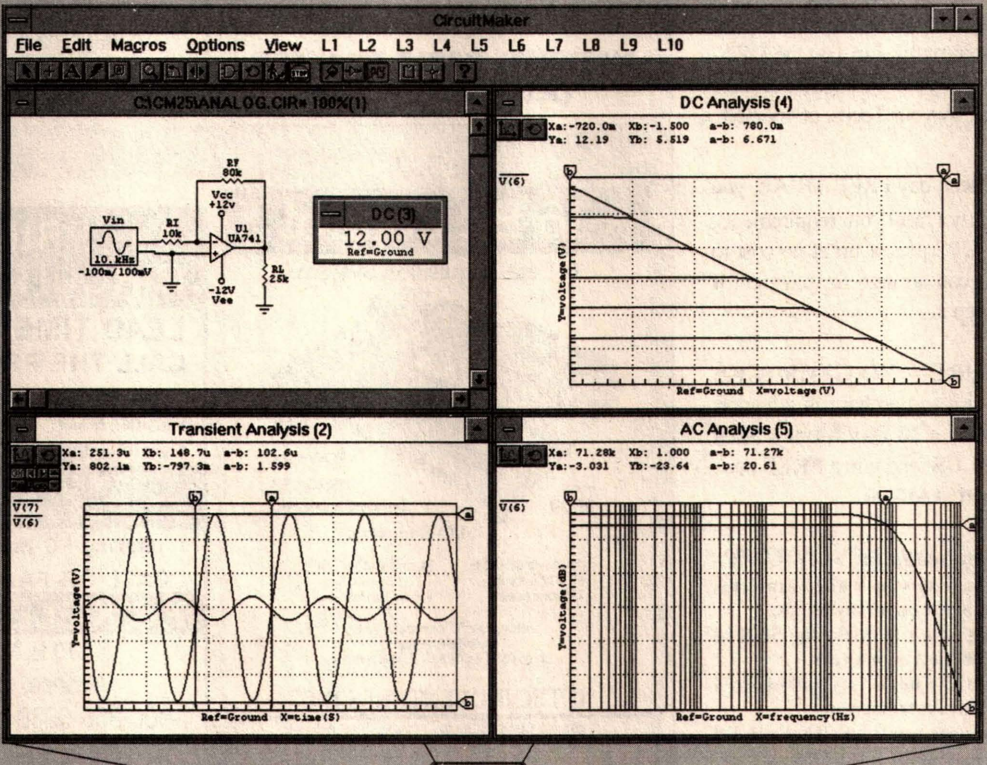
Electronics Workbench offers a single, small scope or Bode plot instrument window. The windows are not sizeable and only two waveforms can be plotted at a time. EWB has a single measurement cursor and provides no direct way to read results from the instruments.

Superior Digital Simulation

CircuitMaker has an exclusive Trace feature where the state of every node is indicated in color as the simulation runs. You can monitor as many waveforms as your screen will allow, set edge or level breakpoints for analysis, and interactively see the state of any node by touching the logic probe to it. The data sequencer provides 1024 words of pattern data. Additional digital instruments include ASCII and HEX input keys and an ASCII display. CircuitMaker includes tri-state devices and devices have programmable propagation delays.

Electronic Workbench has no interactive logic probe or Trace capability and no Hex or ASCII keys. Their "word generator" is limited to 16 words. EWB does not have tri-state devices and digital devices do not have programmable propagation delays.

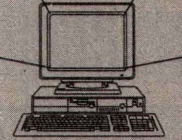


```
12.00 V
Ref=Ground
```

```
Xa:-720.0m  Xb:-1.500   a-b: 780.0m
Ya: 12.19   Yb: 5.519   a-b: 6.671
```

```
Xa: 251.3u  Xb: 148.7u  a-b: 102.6u
Ya: 802.1m  Yb:-797.3m  a-b: 1.599
```

```
Xa: 71.28k  Xb: 1.000   a-b: 71.27k
Ya:-3.031   Yb:-23.64   a-b: 20.61
```



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CircuitMaker includes libraries containing programmable, TTL, CMOS, generic analog and digital devices, and many powerful I/O devices. With CircuitMaker's macro function you can quickly and easily create your own functional devices and symbols. Now that's giving you the tools you need to get the job done right!

Electronics Workbench ships with only 17 digital devices. If you want additional devices you pay extra.

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CircuitMaker puts you in control of your schematic with SmartWires™, bussing, page connectors, and rubberbanding. You can label devices and pins, add fully stylized multiline text, and create a parts list or netlist. With the Macro feature you can add user defined symbols to your device library.

Electronics Workbench dictates wire placement to you. EWB limits your overall "workbench" layout to 2 by1 pages. EWB has no bussing, page connectors, pagebreaks, print scaling, labeling, free text fields, netlisting, zoom, undo, and no Toolbar or Toolbox.

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Comparison based on CircuitMaker 2.6 for Windows and Electronics Workbench 3.0 for Windows. All products and company names are trademarks of their respective owners.

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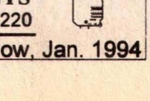

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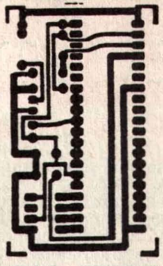

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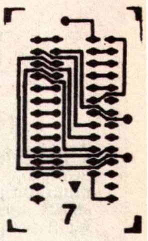

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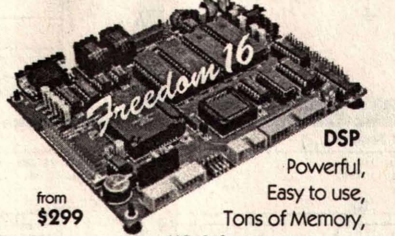

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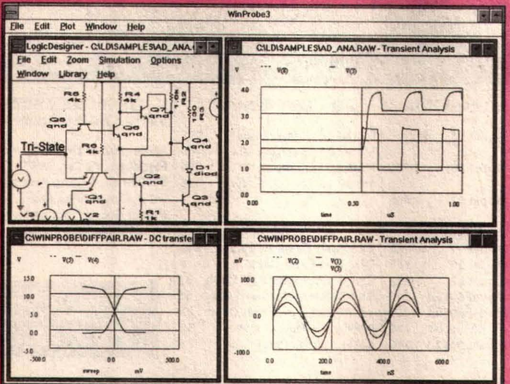
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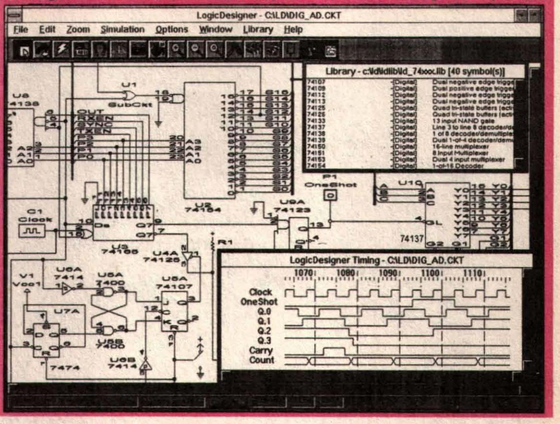
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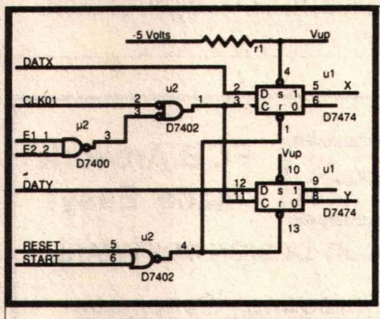
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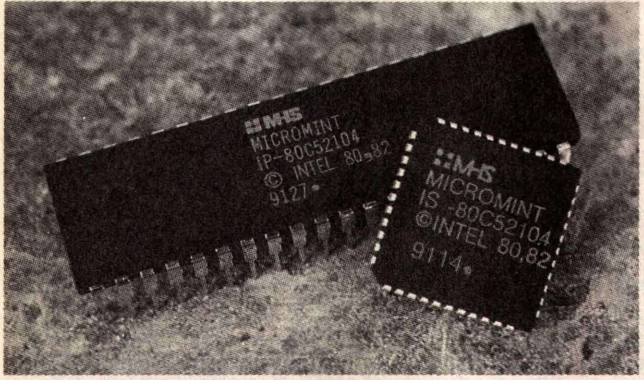

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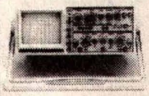

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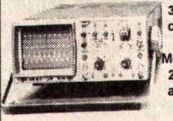

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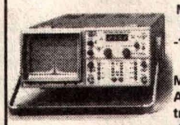

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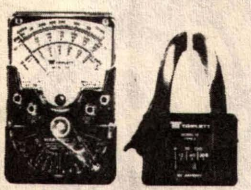

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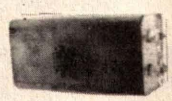

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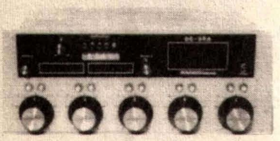

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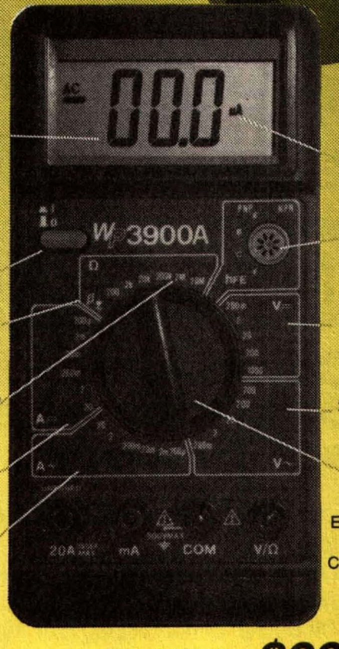

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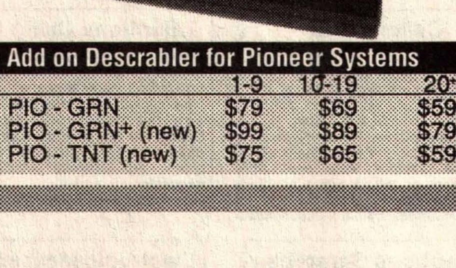

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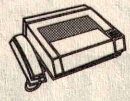

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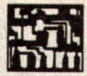

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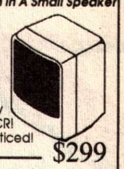

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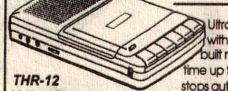

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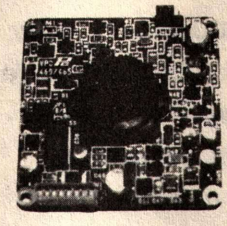

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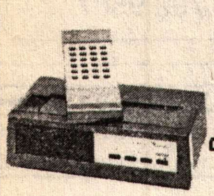

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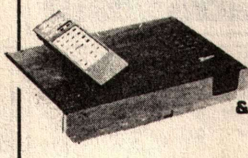

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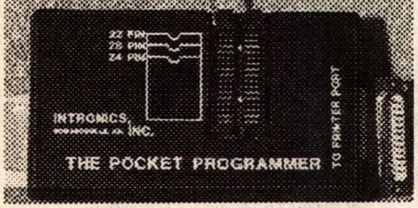

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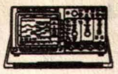

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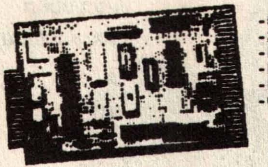

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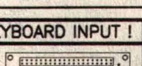

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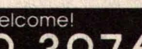

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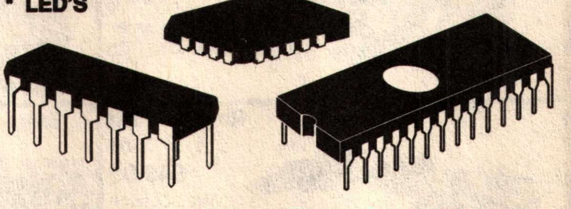

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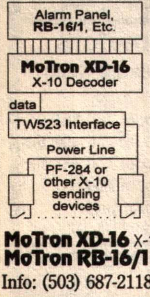
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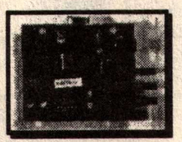

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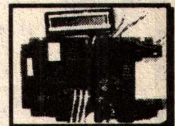

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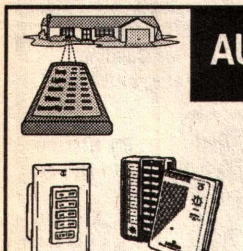

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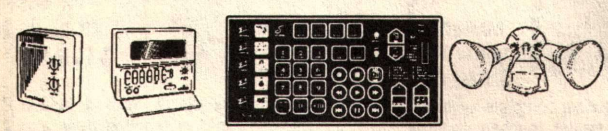

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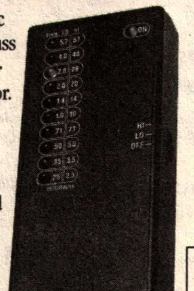

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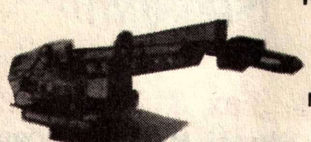

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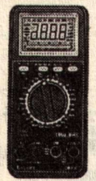

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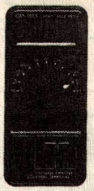

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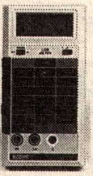

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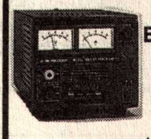

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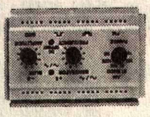

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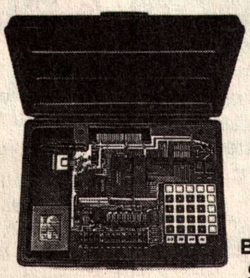

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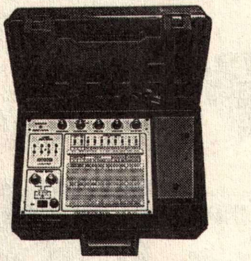

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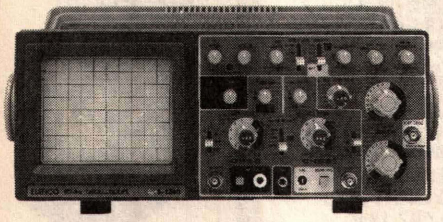

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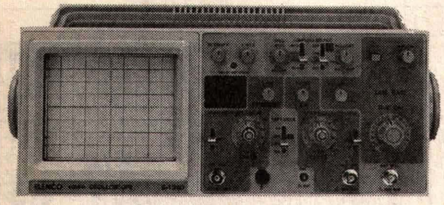

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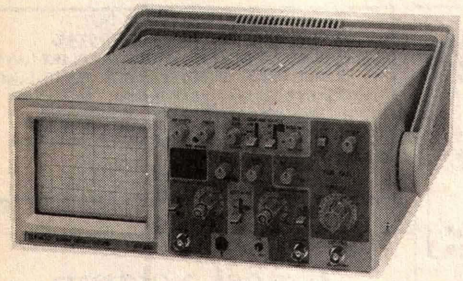

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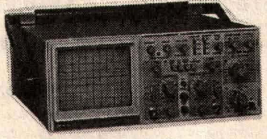

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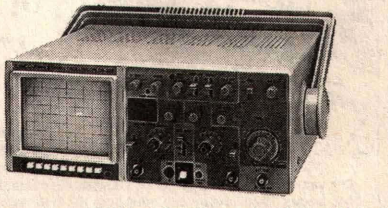

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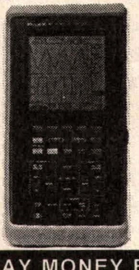

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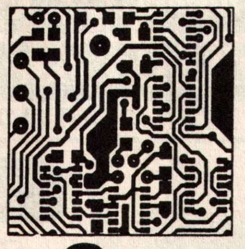

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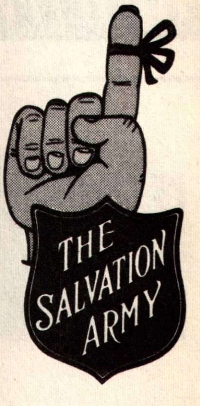

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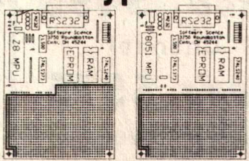

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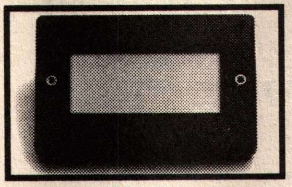

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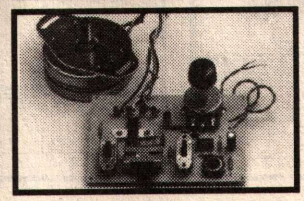

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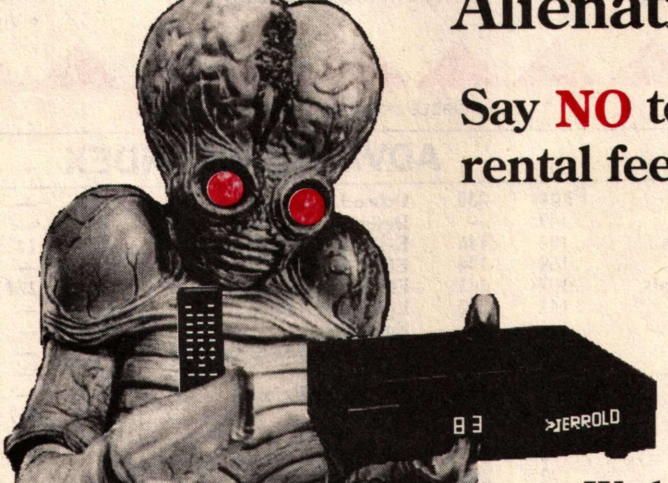

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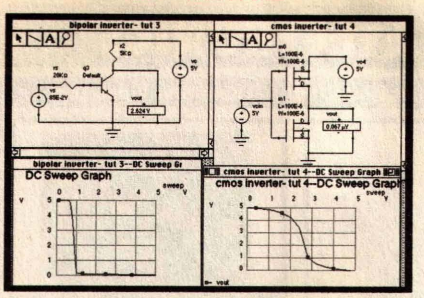
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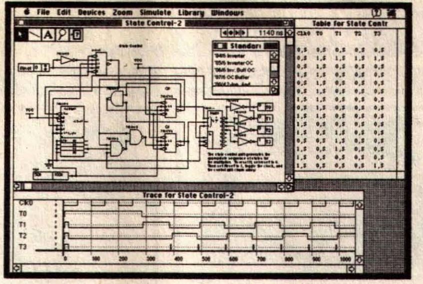
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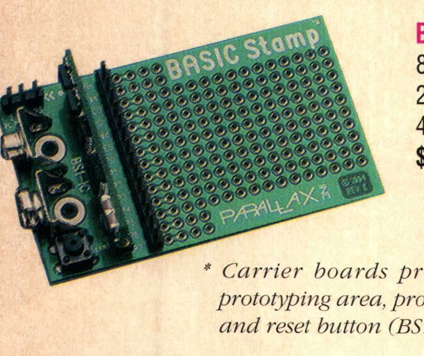

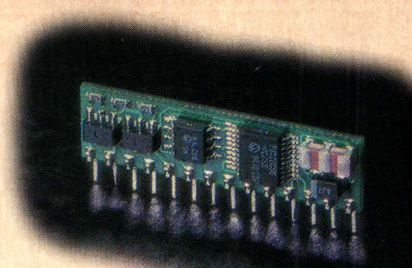

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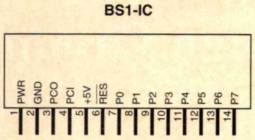
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GND
PCO
PCI
+5V
RES
P0
P1
P2
P3
P4
P5
P6
P7
1
2
3
4
5
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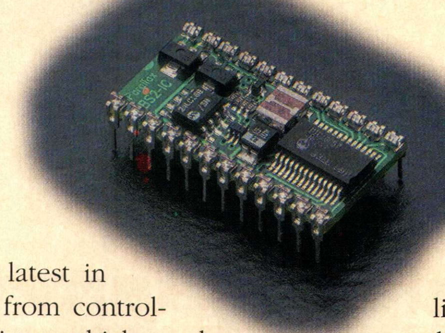

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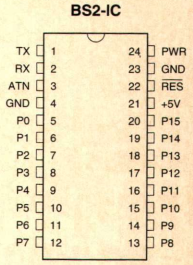
BS2-IC
TX 1
RX 2
ATN 3
GND 4
P0 5
P1 6
P2 7
P3 8
P4 9
P5 10
P6 11
P7 12
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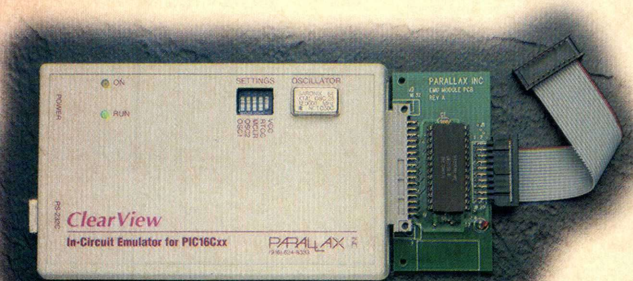
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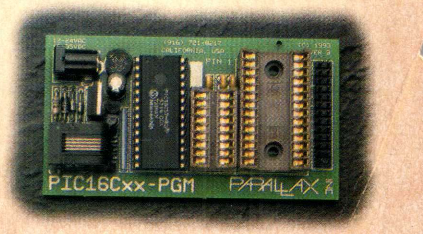
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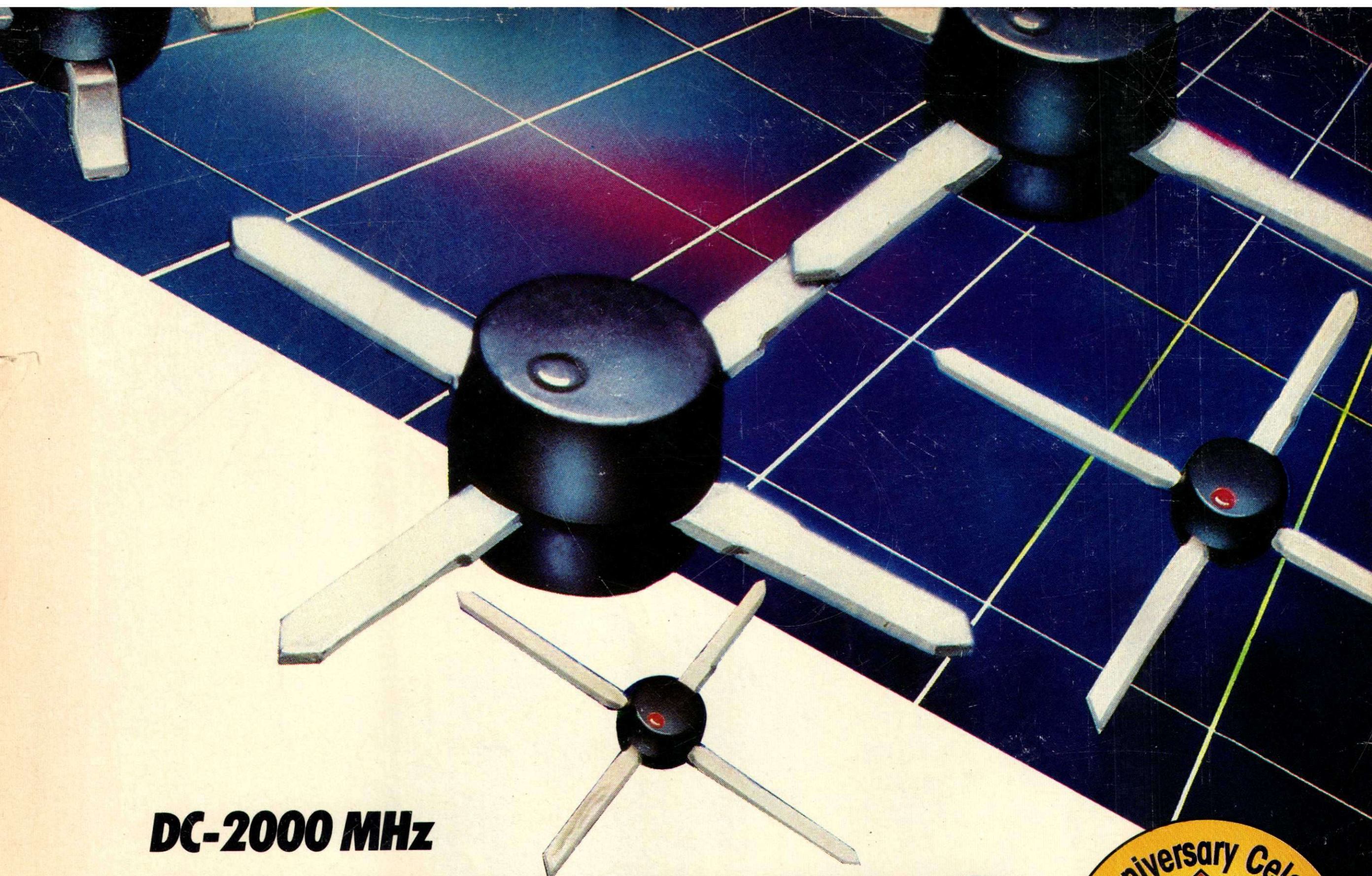

DC-2000 MHz

AMPLIFIERS

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In plastic and ceramic packages, for low-cost solutions to dozens of application requirements, select Mini-Circuits surface mount or flatpack wideband monolithic amplifiers. For example, cascade three MAR-2 monolithic amplifiers and end up with a 25dB gain, 0.3 to 2000MHz amplifier for less than $4.50. Design values and circuit board layout available on request.

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	MODEL	Freq. (MHz) DC TO	GAIN (Typ. dB) At 100MHz	MAX. Power (@ 1dB Compr.) dBm	NF dB (Typ.)	Price $ea. (Qty. 50)
MAR	MAR-1	1000	18.5	1.5	5.5	.99
	MAR-2	2000	12.5	4.5	6.5	1.35
	MAR-3	2000	12.5	10.0	6.0	1.45
	MAR-4	1000	8.3	12.5	6.5	1.55
MAR SM	MAR-6	2000	20.0	2.0	3.0	1.29
	MAR-7	2000	13.5	5.5	5.0	1.75
	MAR-8	1000	32.5	12.5	3.3	1.70
RAM	RAM-1	1000	19.0	1.5	5.5	*6.40
	RAM-2	2000	12.5	4.5	6.5	*6.40
	RAM-3	2000	12.5	10.0	6.0	*6.40
	RAM-4	1000	8.5	12.5	6.5	*6.40
	RAM-6	2000	20.0	2.0	2.8	*6.40
	RAM-7	2000	13.5	5.5	4.5	*6.40
	RAM-8	1000	32.5	12.5	3.0	*6.40
MAV	MAV-1	1000	18.5	1.5	5.5	1.10
	MAV-2	1500	12.5	4.5	6.5	1.40
	MAV-3	1500	12.5	10.0	6.0	1.50
	MAV-4	1000	8.3	11.5	7.0	1.60
MAV SM	MAV-5SM	50-1500	8.0	18.0	6.5	2.07
	MAV-11	10-1000	12.7	17.5	3.6	2.10
VAM	VAM-3	2000	11.5	9.0	6.0	1.45
	VAM-6	2000	19.5	2.0	3.0	1.29
	VAM-7	2000	13.0	5.5	5.0	1.75

*Qty. 10

MAR & MAV MODELS: Plastic flat pack...for surface mount, add S suffix to model number and 5¢ to price. Example: MAR-2SM...$1.

MAV-5SM available plastic surface mount only.

RAM MODELS: Ceramic surface mount.

VAM MODELS: Plastic surface mount.

DESIGNER'S KIT, KH-1 available only $59.95 includes:
40 AMPLIFIERS* 10 MAR-1, 10 MAR-3, 10 MAR-4, 10 MAR-8
150 CAPACITORS* 50 100pf, 50 1,000pf, 50 10,000pf
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MIXERS • POWER SPLITTER/COMBINERS • AMPLIFIERS
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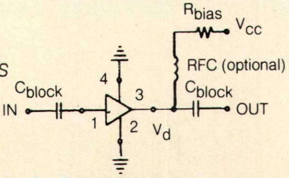
** Values or models may be substituted without notice, depending on supplies.*

Typical Circuit Arrangement



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